

The Blast Furnace *and* Steel Plant

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Conventions

THE months of May and June have become a time of rendezvous. Men meet at many places and, on a plane of common understanding, devise better ways of extending their joint or competing fields of influence. Could there be better evidence of the innate human desire to work co-operatively, and to bear the weight of broad impersonal perspective upon otherwise personal problems?

When we observe a gathering of Sheet Steel Executives, such as filled the Greenbrier at White Sulphur Springs, or the thousand steel men who graced the board at the Commodore, where the American Iron and Steel Institute held annual session; when we read the proceedings of the National Electric Light Association, which gathered its enthusiastic members at Atlantic City, coming from all points of the compass, and the various associated divisions of the American Society of Mechanical Engineers with co-operating societies, combined under the roof of the Hotel Cleveland, we realize the extent to which this form of community of interest spirit has grown.

In the remarkably frank atmosphere of friendly discussion which pervades each of these conventions, stands our most substantial bulwark against foreign aggression or lasting depression.

How entirely different from the blare and secrecy of those other two national conventions soon to influence four years of American life, where mob psychology in the name of politics will usurp the place of Reason, and personal ambitions will be achieved.

Straight Line Production

Woodward Iron, Alabama, Presents Many Unusual Operating Features

By F. J. CROLIUS

PART II

THE cars at both the No. 1 and No. 3 Dolomite mines are discharged without detaching them from the hoist rope. The tippie at the No. 1 mine has been in operation since 1918 and that at No. 3 for a slightly shorter period of time. Thus far neither has failed to perform its duty properly, nor has either caused any delay or expense in its operation.

Both of the tipples described in the foregoing are used for handling coal, the weight of each loaded car being about 4,600 pounds.

At the Redding mine another 5-car dump of the same type handles ore cars. This is located 400 ft. below the surface and is set at an angle of $17\frac{1}{2}$ deg. A trip of five cars, the gross weight of each being three tons, is brought into the dump and discharged into a 300-ton bin. Thence the ore is dropped by a roller feed gate into a measuring pocket, whence it passes to an 8-ton skip which is hoisted in a vertical shaft to the surface. The contents of the skip is then dumped into a bin feeding a gyratory crusher and from that point

discharged as needed into railroad cars. The capacity at this mine is 1,200 tons in 10 hours.

As these mining operations lead up to a single conclusion, the production of foundry iron, a point in passing is worth noting. Practically every ton of coal mined is sampled, tested for bone and slate and recorded in terms of the man that loaded it.

Located underneath the tippie is a sampling room. As each car dumps its load, 100 lbs. of the coal drops into a gravity chute leading into the sampling room. There it passes onto shaker screens and picking tables, where boys carefully separate the slate. This is automatically weighed and recorded. So carefully is total operation checked against the car loader by the individual's number that frequent repetition of unduly high slate content is immediately evident and corrected. All miners work on a bonus system related to an average slate base, and this system is nearly infallible.

We have described the journey of the ore to the bins at the blast furnaces. Almost the same works

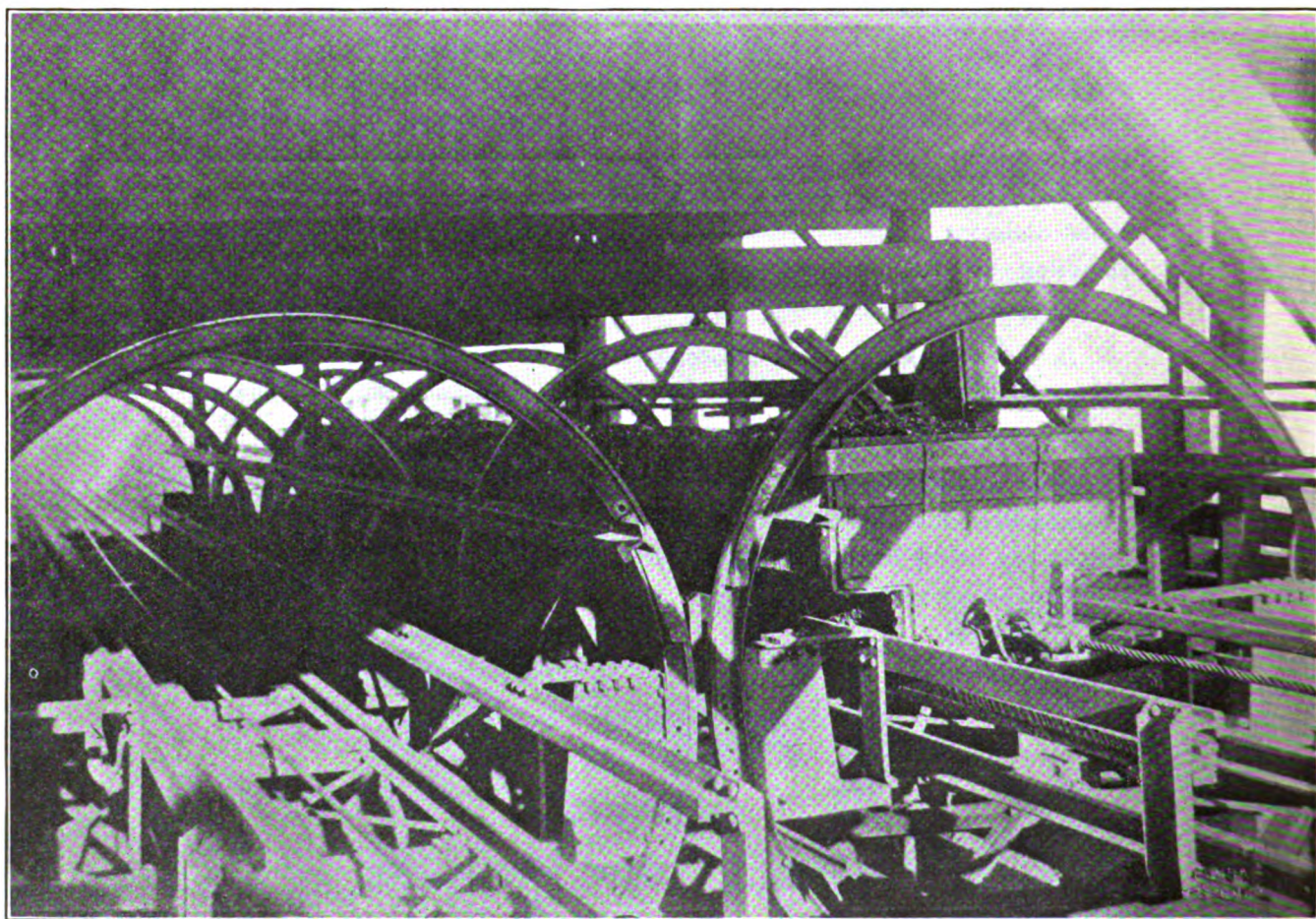


FIG. 7—The simple tripping of a latch causes five cars of coal to dump their loads simultaneously, the cars to whirl back into position and start on their return to the mine.

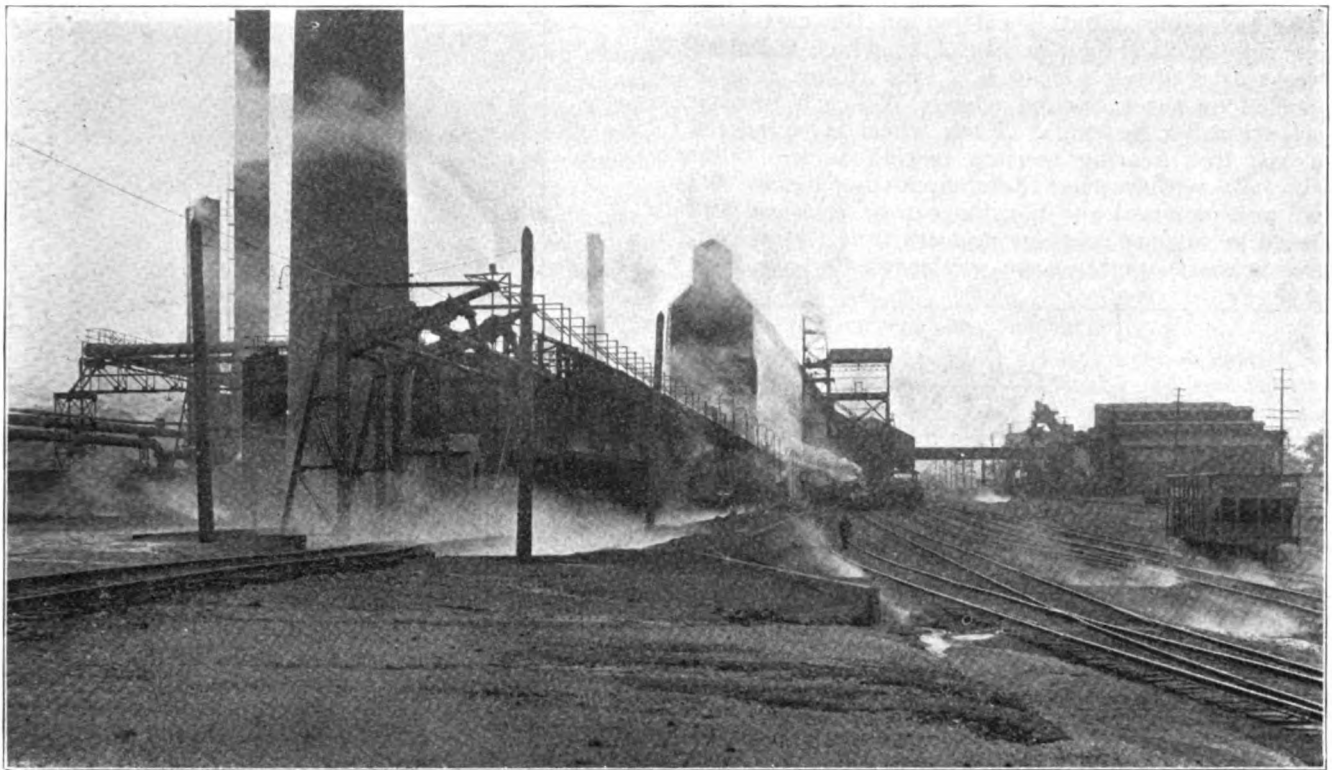


FIG. 8—Here are shown a view of the 230 by-product ovens from the railroad main line side. At this plant, the first Edison Benzol recovery plant was installed during the war.

would cover the coal to the coke ovens, except that a Link-Belt washer interposes an intermediate station. As by-product coal demands pulverizing or fine crushing, advantage is taken of this subdivision to reduce the normal 15 per cent ash native in the coal as mined, to an average of less than 5 per cent as charged in the coke-ovens.

The operation of the Link-Belt washer is interesting. Intrinsically, water is all-important, and as in most Birmingham plants very little is allowed to escape. The life of a gallon of water resolves itself into about 50 cycles through the complete system.

At the washer proper, water is circulated in a closed circuit, which picks up the crushed coal as it leaves the coal bins under the tressel, carries it into the separating chambers where the first slate is caught, over flows with the cleaned coal into a secondary separator and discharged at the bottom of a belt conveyor, which hoists the moist coal (carrying 20 per cent water) and conveys it to the centrifugal driers. The water is recovered in a sump and although heavily saturated with 200 mesh coal dust, is returned to the primary circuit. The 20 per cent water in the discharged clean coal is recovered all but about 20 per cent in four great centrifugal dryers, which discharges upon a belt conveyor to the coke-ovens. The capacity of each of the four dryers is over 70 tons of coal per hour.

The coking operation is the familiar Koppers process, with ammonia and benzol recovery. This is the first Edison benzol plant constructed in this country during the war. There are 230 12½-ton by-product ovens, making 18 hour furnace coke. Tar is sold to the American Tar Products Company, who distill into its derivatives. By-product gas is used in regenerators, and excess finds its way to several batteries of boilers for steam production and power.

As coke, broad gauge cars receive the product from the pushers, transfer it directly to the quenching station, then discharge it into the stock-bins previously described.

At the top of skip hoist the furnace charge meets another interesting feature. In its course into the burden it is distributed by a Crockard top.

The Crockard Furnace Top.

A number of years ago, the Crockard top was applied to several of the Ensley furnaces of the Tennessee Coal, Iron & Railroad Company, with marked success. The first furnace so equipped made about 1,400,000 tons of iron on one lining.

A simplified and improved design of this top was applied to No. 2 Woodward Furnace in 1921. This furnace was blown in on November 21, 1920, and to date has produced about 320,000 tons, with no indication of trouble from the lining.

Briefly described, the distributor consists of a revolving spout, carried on rollers and actuated through a train of spur gears by the counterweight cable from the skip hoist. An ingenious application of the roller friction or "Star" clutch secures rotation of the distributor in one direction only. The spout revolves while the skip is ascending, and clutch disengages when skip starts lowering. Fig. 1 shows the construction of clutch. The outer ring or housing is of cast steel, keyed to the shaft and having hardened steel roller race pressed in. The steel rollers are 2 in. diameter hardened and ground. The star clutch is cast integral with gear and carries hardened steel wearing plates for rollers. The clutch engages or disengages instantly with practically no lost motion or back lash. By choosing the proper gear ratios, any desired angle of rotation can be secured. At Woodward, the distributor is turned 67½ deg. between each skip.

The revolving spout is carried on the cast steel riding ring A, as shown in Fig. 2, to which is bolted the cast steel driving gear B. This riding ring is supported on three flanged wheels W—each turning on Hyatt roller bearings. Each wheel is supported in a cast iron bearing housing resting on iron filler blocks. By withdrawing these supporting blocks, the entire unit of wheel and housing can be removed and replaced by a spare in a few minutes time. However, in two years of operation, no replacements have been

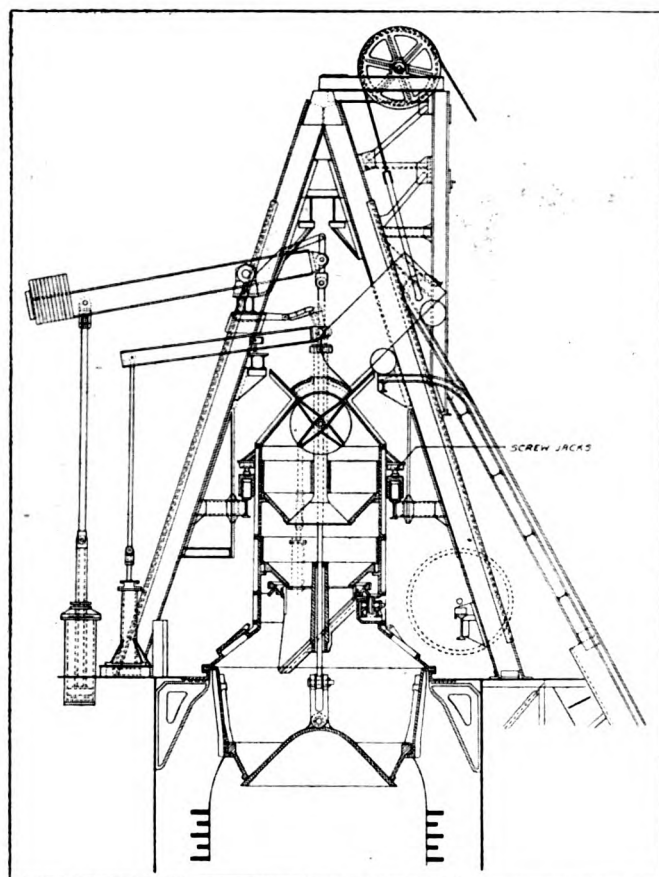


FIG. 9—The Crockard furnace top. Distribution of the charge is now recognized as one of the most important elements in successful blast furnace operation. Simplicity, ruggedness, reliability are the foundation stones upon which this design is based. Its mechanical movements are not dependent upon external motor power.

necessary. The entire revolving portion is centered by the wheel flanges and the thrust of driving pinion is taken by rollers, R—spaced 120 deg. each way from pinion.

The driving force is furnished by the friction of counterweight cable wrapped 180 deg. around the sheaves "S" as shown in Fig. 3. That the resistance to turning is slight is evidenced by the fact that the sheave shows no sign of wear from the slippage of the cable. This result is attained by careful attention to bushing and lubricating all bearings and to the interposition of a flexible coupling between the separately supported units of the drive, which prevents any tendency to bind. The openings around the three supporting rollers are closed with thin plate to a very small clearance, so that leakage of dust and gas is so small as to be negligible. All gears, as well as the roller clutch, are enclosed. The entire driving mechanism is of simple and rugged construction and has occasioned no delays to the furnace operation.

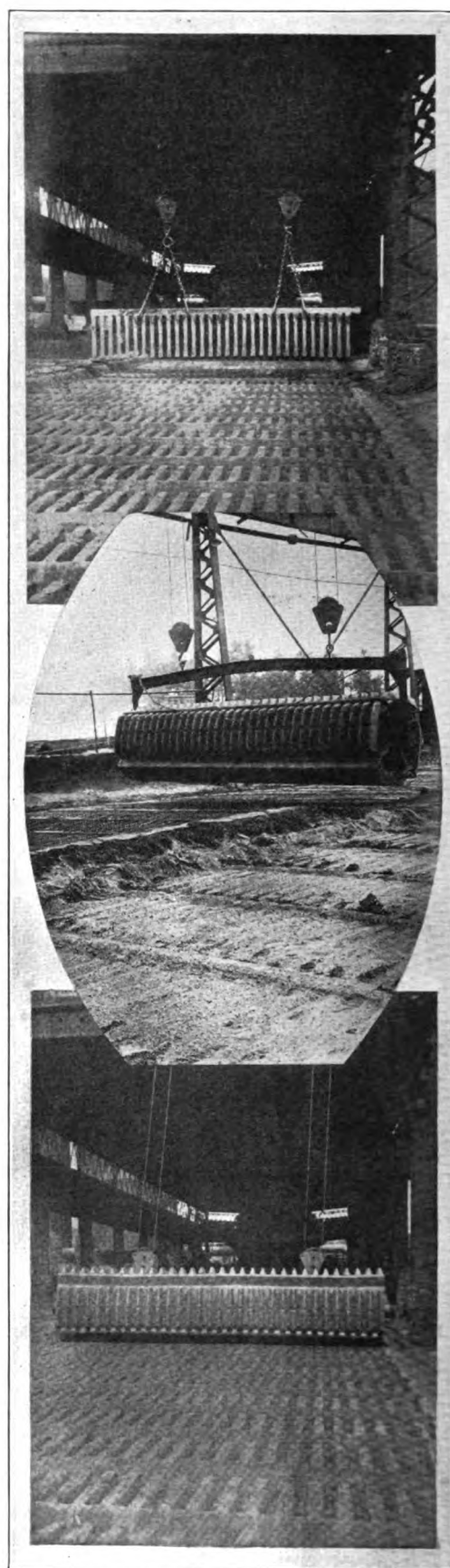


FIG. 10 — "Comb" or bed of pig iron made from bed moulder. Comb is en route to pig breaker. Center—View showing front and end of moulder. Lower—View showing character of moulding done with "roller." A very simple and most effective solution of the pig casting problem, which is typical of the methods developed by the Woodward organization.

The Woodward furnaces are single skip furnaces, and to counteract any possible segregation of the charge in the receiving hopper, a pair of baffle plates has been placed at the top of this hopper as shown in the general arrangement of the furnace top. These baffle plates on either side of central bell rod split the charge on the principle of the well known sample riffle. Between skips, each baffle is automatically revolved 90 deg. and half the skip load is thus directed to alternate quarters of the furnace, thus obviating the possibility of any section receiving a preponderance of fines. Rotation of baffles is effected by small 8-in. steam cylinders which are interlocked with the little bell cylinder so that the entire operation is automatic. This mechanism has proven very satisfactory, and requires no attention other than periodical replacement of wearing plates.

Particular attention has been given in the design of this top to facilitating a possible change of furnace bells. The receiving hopper has brackets cast on which rest on two-wheel trolleys running on I Beams, which enable the whole receiving hopper and distributor to be moved back to clean the main hopper. In making this change the bell rod clevis is disconnected, the bell being supported meanwhile on temporary beams thrown across the hoppers. The two bell beams are next disconnected and the bell rod lashed to the top hopper. A few turns are given to the screw jacks on supporting trolleys and the entire top above gas seal is lifted to clear and can then be pushed back to clear the entire center of furnace. Bell and lip ring can then be swung from the upper trolley and removed. By this means, the replacement of main bell can be made in one third the time required on the furnaces not so equipped, where

it is necessary to remove the entire top piecemeal and then re-assemble it.

The successful operation of this top has led the management to install it on a second furnace. No. 3 Woodward was thus equipped on its last re-lining and was blown in about the first of the present year.

The Pig Bed Machines.

One of the labor saving devices that has been introduced at Woodward is the pig bed roller and harrow machines that prepare the sand bed for the cast in a few minutes when it formerly required a force of "sand-cutters" two or three hours.

After the previous cast has been removed the bed is thoroughly wetted down by an overhead spray system that is easily controlled and that gives a uniform soaking to the sand bed. This wetting puts the sand in proper condition for moulding and incidentally exposes any pieces of iron or scrap on the surface of the sand. These are removed before the operation of harrowing.

The harrow consists of a rectangular frame having an 8 in. double extra heavy pipe for the front member, a 90 lb. rail for the rear member with two side members of $\frac{3}{4} \times 6$ flats bent in the form of sled runners. These prevent the teeth from digging too deep into the sand. The teeth bolt through the 8 in pipe at 5 in. spaces and are set to loosen the sand to a depth of 9 to 12 in. The rail rear member smooths the bed and helps to grade the bed to desired level. About two trips are made over the entire length of bed with the harrow which is the same length as the width of the bed. Harrow is dragged through the sand to-

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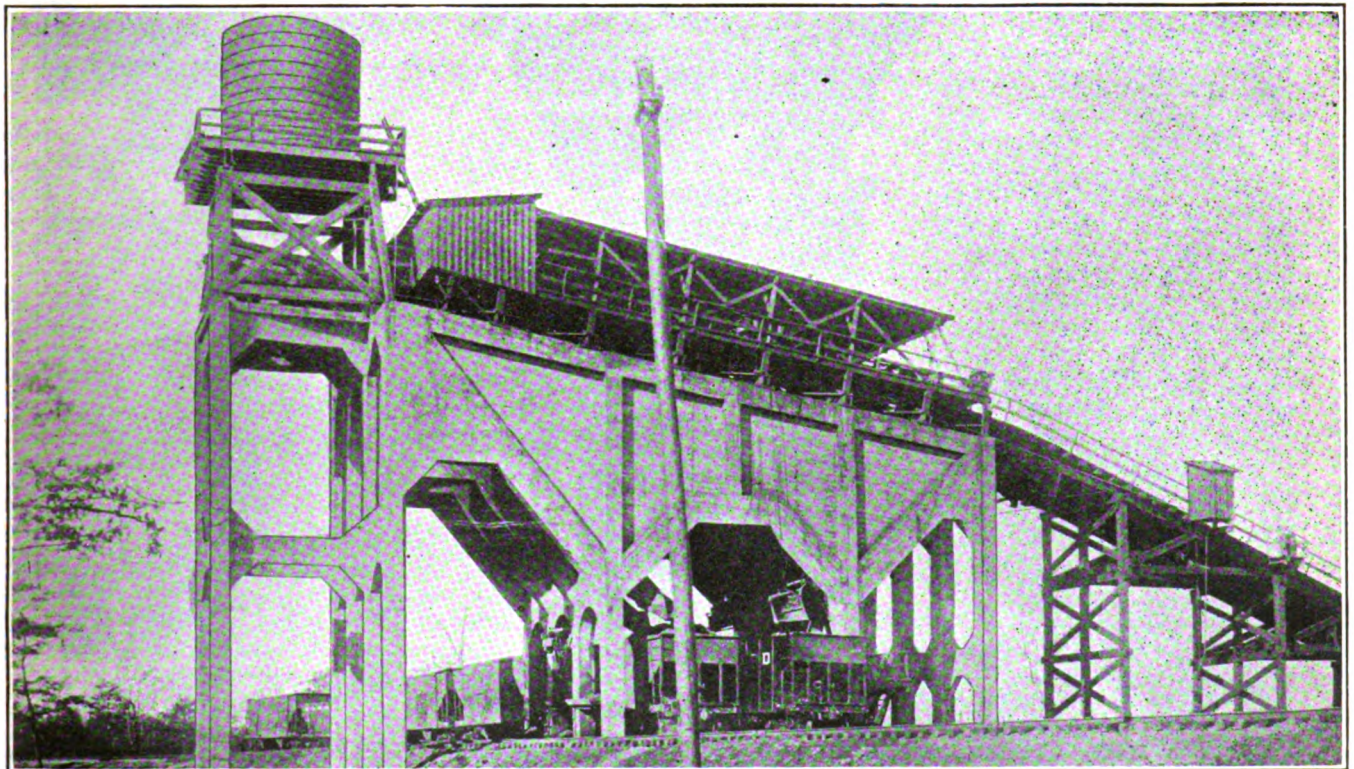
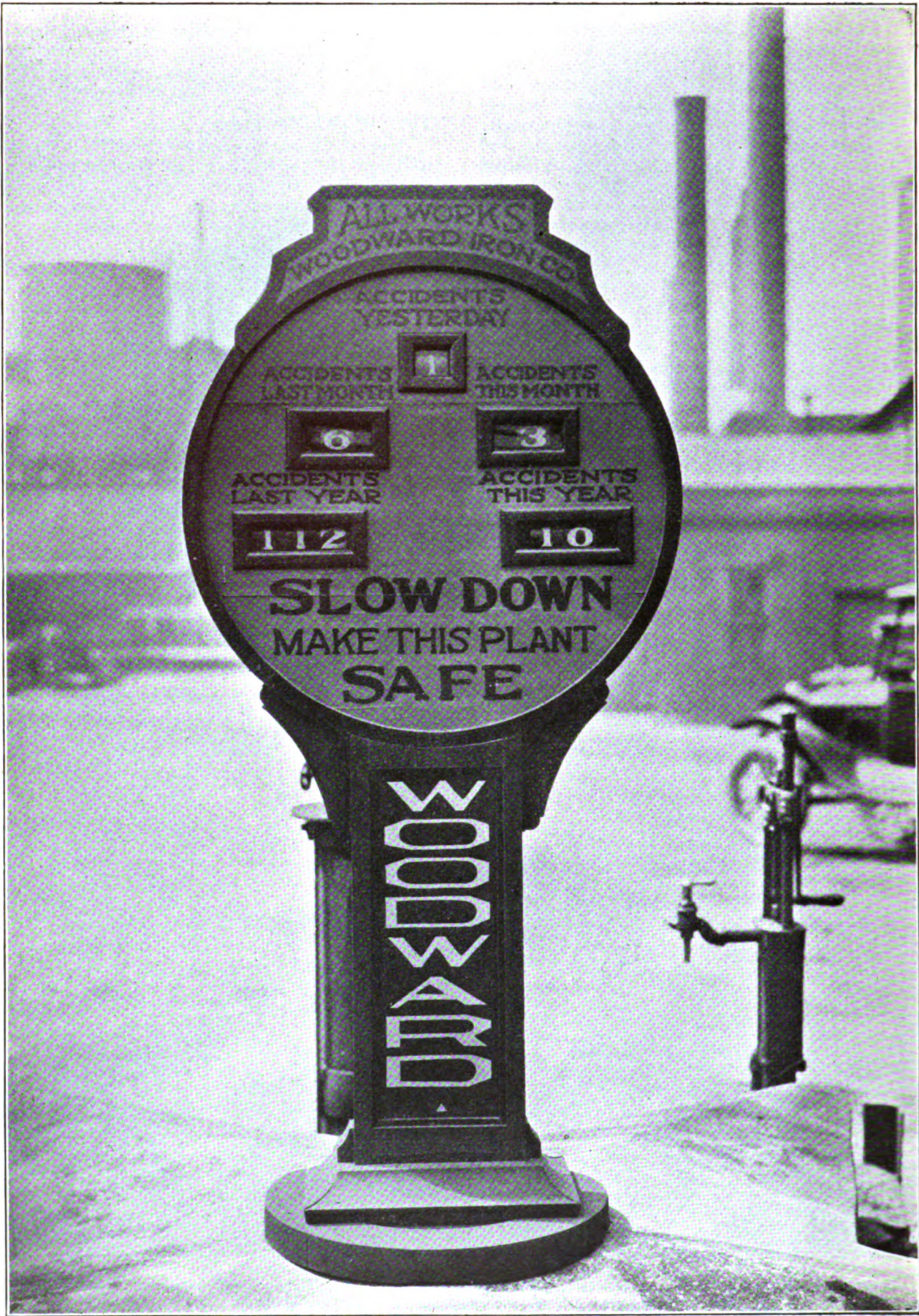


FIG. 11—Dolomite No. 3 is a fine example of a modern slope coal mine. As can be seen from the picture, the surface structures, including the new hoist-house (not shown) are of solid concrete. The top of the incline terminates in a Rolls-Rite tippie, where the trips of five cars are automatically dumped as a unit, by the mere throwing of a lever by a single attendant. Nothing could be simpler, more effective nor expeditious. Thirty seconds after the cars reach the top, they are on their way back to the mine.



The first and last thought at Woodward.

THE SAFETY CRUSADE

Prevention of Accidents by Educational Methods

Abstract of an Address Delivered Before the Metropolitan Section
of the National Electric Light Association in
New York City, May 2, 1924

By ARTHUR WILLIAMS*

THE man who holds the most important safety job in America, and probably in the world from the standpoint of the number of employes affected and the money invested, has said that he would rather accept responsibility for accident prevention in a plant that did not have a single mechanical safety device, but where there was the spirit of safety among the workmen and managers, than in a plant where there was every known physical safeguard, but not this spirit of safety. This view is undoubtedly sustained by the earlier experience of our own company to which I have referred, where the mechanical or electrical human safety device was unknown, and yet, because of the care exercised by everyone, accidents were practically unknown. This is perhaps the best commentary on the extent to which education may be relied upon and is demanded for the prevention of industrial as well as civic accidents.

Safety Museum.

Another indication of the value of education in this direction can be seen in the exhibits of the American Museum of Safety. For many years after the opening of the Museum in 1907 the exhibits were confined to machine guards, safety devices and safety materials; in the new Museum of Safety, which is maintained in co-operation with the New York State Department of Labor, photographs, stereopticon slides and other graphic exhibits show the schools for foremen, safety meetings for workmen, bulletin board posters, safety magazines, and numerous other educational means which are now being used effectively for the prevention of accidents in factories, mines, and public utilities.

Mechanical vs. Educational Methods.

Professional safety engineers who have watched the development of the accident prevention movement from its infancy say that even today, with the hundreds of ingenious safety devices available, with automatic machines which are almost fool-proof, and with safety incorporated in the design, construction, and installation of industrial equipment, it is possible to prevent only 25 to 50 per cent of industrial accidents through mechanical means, and that for the preven-

tion of the rest we must turn to educational methods, better supervision and improved morale of employes.

This estimate is borne out by a recent analysis of some 300,000 accidents which occurred over a period of many years in the plants of the subsidiaries of the United States Steel Corporation. This analysis showed that hand labor was responsible for more than 40 per cent of these accidents. In commenting on this, Mr. Charles L. Close, manager of the Bureau of Safety, Sanitation and Welfare, said the majority of these accidents could not possibly have been prevented by the use of mechanical safety devices or appliances. They were due to carelessness and the failure of workmen to observe the simple precautions conducive to safety. That is why we must devise and perfect educational methods of accident prevention.

Safe Workmen Best Safety Device.

What is true in the plants of the Steel Corporation is undoubtedly true throughout the industries and in public utility operations. Nowhere is the saying that a safe workman is the best safety device more true than in public utility operations. In most utilities safety and ordinary operating efficiency are so closely interrelated it is impossible to draw the line between them. The New York Edison Company, in the training of its operating employes, gives special attention to the question of accident prevention. For example, every employe is taught the prone pressure method of resuscitation, not alone as a first aid or safety measure, but as part of his general training. In that company are 300 men trained to give instruction in prone pressure resuscitation, and I have been told that approximately 5,000 of the employes of the company have received this instruction and are required to practice this method at least once in four months.

Training in Safety Part of the Job.

Every employe in the operating department of the company knows, for instance, that a prerequisite to promotion to any job is a thorough knowledge of the safety rules and practices of that job as well as of his own. He must know not only what is the safe thing to do in any given circumstances likely to arise on that job, but why it is the safe thing to do. In other words, the company requires of its employes not mere obedience, but a thorough understanding of what they are doing. Only through such understanding can you have safety in the operation of public utilities.

*General Commercial Manager, the New York Edison Company, and President, the American Museum of Safety.

And only through educational methods can you bring about that understanding.

Safety Measures Topic Throughout the Whole Company.

A great deal of the safety education of employees in the New York Edison Company is brought about through talks to the men in groups and as individuals. The company, of course, uses safety bulletins, magazines, motion pictures and the other educational means in common use.

There was a time when most accidents were attributed to carelessness and when we made little effort to find out just what caused or constituted carelessness, but that time is passed for most employers and I think for most public utilities.

Today we know that carelessness is as much a frame of mind as it is a bodily habit and we are beginning to find out what causes that frame of mind and how to change it.

We know, for instance, that lack of confidence in the sincerity of the employer or failure to understand the motives of the employer are often responsible for the frame of mind which is conducive to accidents.

Experience of a Standard Oil Company Safety Engineer.

This point is illustrated by the experience of a representative of one of the Standard Oil Companies which recently came to my attention. Like most other safety engineers, this man found that a number of their oldest and best employes simply would not take the safety work of the company seriously. When everything else failed, he tried this: he would get into a conversation with the workman or foreman who refused to observe safety rules and practices and would say, "John, what do you think of this company, anyhow?" In nine cases out of ten, John would say that you couldn't find a better place to work anywhere in the world and would then go on to enumerate all the things he liked about the company. When he was through, the safety engineer would say, "Well, John, now that you agree with me that the company is giving its men a square deal, do you think you are giving the company a square deal when you persist in dangerous practices which may cause an accident to you or to the men around you and that this accident in addition to the injury to yourself and your fellow-workers might cost the company thousands of dollars?"

This representative has said that invariably the worker's response is: "I must say I have never thought of it that way and you can bank on it that from now on I am going to play the game squarely with the company and there will be no accidents around here if I can help it." That representative's work represents probably the highest type of accident prevention through education and there is room for a great deal of such work in every one of our great industries.

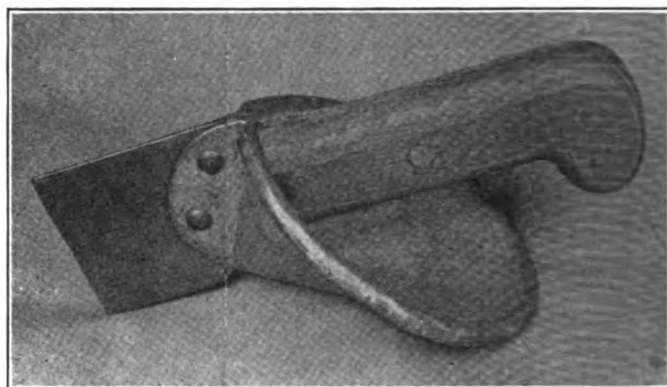
Caution Has Been Subordinated.

Safety education in the major sense probably means that development of oneself so that he is constantly, automatically, sub-consciously on guard against accident. Many years of personal safety in the character of the work done in a shop, or the traffic upon the highways, has subordinated or practically eliminated the element of caution in every human being. Going back to the early days of the republic,

you recall how everyone was always on guard and any unusual or unexpected sound, like a rustling twig or a cracking stick, brought one to immediate attention, looking for possible danger. Today, every industrial activity is accomplished through the aid of high speed and dangerous machinery; a very large percentage of our population lives at great relative heights from the ground; highways, even in the otherwise quiet, secluded country, are occupied by heavy, high-speed traffic that makes them more dangerous than the usual right of way occupied by a railway. The dangers of the early days of the republic are multiplied a thousand-fold on every hand, and we must train ourselves to be constantly on the watch wherever we are, in a power plant, factory, on the highways, or traveling by boat or train.

The safety movement of the country has resulted in the development of a new profession in our industrial life in which, at the moment, there are probably no less than 5,000 men giving their entire time to this work as a life profession. I have seen large gatherings of these men who, collectively, seemed to represent a combination of a lawyer, a doctor, and a minister, such has been the result of the practical constructive interest in every phase of human welfare. These men should be considered in the highest sense as elements of economy and efficiency in our industrial and commercial life, for in every instance organized safety effort, both in plant equipment and education, pays and pays handsomely.

This knife was perfected two years ago by J. L. Junkin, safety director of the Wheeling Steel Corporation, Steubenville plant, and since it has been placed in use in the sheet mills there they have not had a single cut hand or arm where this knife has been used. Once in a while it was found at first that some of the openers would make their own knife without



the hand guard on it and the result was that there was very soon a cut hand or arm case at the hospital. With the co-operation of the sheet mill superintendent and his force, the old style knife was soon eliminated, and now no one thinks of making or using any other kind of a knife. The basket hilt or guard is made of about 14-gauge galvanized steel and the handle of fiber, with copper rivets through same. The blade is best made of good spring steel, to avoid bending and scouring sheets. Electric alloy steel makes the best blade, of sufficient length and weight to suit the opening to be done. This knife has not been patented and any one is free to use same.

From accidents of 10 to 12 per day to none is a very good record for any safety device.

Gas Producer Practice*

Conclusion of Valuable Paper Presented Before the American
Iron and Steel Institute

By WALDEMAR DYRRSEN†

BLAST furnace gas presents another cooling medium that should not be overlooked. This gas withdraws heat if introduced into the fire zone, principally by being heated up, but at temperatures of gasification above about 1700 deg. F. part of the CO₂ is broken up by C into CO. For the benefit of those especially interested, the calculations for a gasification temperature at 2200 deg. F. are given in Tables XXIII, XXIV and XXV.

From a theoretical viewpoint, the use of blast furnace gas as a cooling medium has many advantages. It is also of uniform composition and temperature. The introduction thereof into the producer, however, presents a problem. Two methods can be used: 1—The introduction of air and blast furnace gas separately in the producer at separate periods. This method would be similar to the production of water gas, except that only the blast consisting of air during the first period, and the blast gas during the second period, are to be reversed. The gas made during each period passes into the same flue. When two or more producers are operated in parallel on the same main, constant composition of gas is obtained. In the production of water gas, automatic control of reversals is often used. This can also be done still more easily in this case, and there would be little labor connected with the reversals. 2—The mixing of air and blast furnace gas together in the blast pipe near the blast distribution hood in the producers. The proportion of blast furnace gas to air is so small that the mixture is not explosive and furthermore the velocity in the blast is too great for combustion to take place. After entering the ash zone, the mixture could burn, but this would take place at about the same place as it enters the gasification zone. If proper check valves are arranged in the air and blast furnace gas pipes, it is possible that this method would be practical.

Savings Possible by Using Waste Gases in Place of Steam for Cooling the Fire Zone.

About 10 years ago the cost of steam in gasifying coal was comparatively a small item as compared to the total cost of gasification. This condition has gradually changed, especially since the advent of the mechanical labor saving producer.

Under present practice and prices, the cost of steam constitutes from 30 per cent to 50 per cent of the total operating cost of gasification. The cost of steam is, therefore, of tremendous importance. If waste heat boilers are used in the open hearth, the producer steam corresponds to 25 per cent to 35 per cent of the total steam made in these boilers. Including the investment charges for producing the steam, the cost is still higher than that given above. The mechanical work that this steam accomplishes in creating the required blast pressure could be done by electro-motor-driven fans with 2 or 3 kwh., or for \$.02

*Read before the American Iron and Steel Institute at New York, May 25, 1923.

†United States Steel Corporation, New York City.

to \$.03 per ton of coal. Nearly the total cost of the steam, therefore, could be saved by the use of waste gases.

Modern Types of Gas Producers.

Hand-poked, hand-filled producers of different types, such as Siemens, Duff, Laughlin, Bradley and others, are extensively used in the United States. They probably constitute 75 per cent of the total number of producers used in the steel industry, and gasify about 55 to 60 per cent of the total coal used in producers. A description of these is, however, outside the scope of this paper.

The modern partially or completely mechanical producer is a development of the last 20 or 25 years, and the most rapid development has been made during the last five years. The historical development will also be passed over. The rapid advancement of modern producers is due to the many experiments, with their failures as well as successes, and to the foresight of practical men and those interested in the subject. In the early days of experimentation, failures were frequent and the investigators were sometimes forced to change their ideas radically as to how a mechanical producer should be built. At the present time, the development is going on perhaps more rapidly than at any previous time. There are, however, on the market today, a number of very successful mechanical producers, which do extremely good work.

The mechanical features of a producer may be divided into three parts:

- 1—Automatic coal feed.
- 2—Automatic agitation of the fuel bed.
- 3—Automatic agitation of the ash zone.
- 4—Automatic ash discharge.

The most used coal-feed is the drum type. In the Chapman producer the drum type coal feed charges the coal into the center of the producer and a special cone distributes the coal over the fuel bed. In both of the Hughes-Wellman producers, there are one or two drum feeds, depending upon the size of the producer, placed between the center and the edge. The Morgan and the Wood producers also have a drum feed, placed in a similar position. In these three types the fuel bed rotates and the coal is distributed over the whole fuel bed. The Keperley producer is not equipped with automatic feed.

The agitation of the fuel bed is of great importance in a mechanical producer and saves more labor than the other items. Practically every farm implement used for breaking up the soil is represented in gas producers—the plow, the tooth and disc harrow, cultivators, spades, etc. The agitator in the Chapman producer consists of a horizontal bar fastened to a central shaft extended through the top, with driving mechanism above. The horizontal bar is equipped with tips pointing at an angle downward in the direction of rotation. The bar can adjust itself to the level

of the fuel bed. This agitator has been successfully applied to hand-poked producers and other mechanical producers not equipped with surface agitation, as for example, the Kerperley producer. The Hughes producer has a swinging poker, which extends 10 to 12 inches down in the fuel bed. On the Hughes-Wellman producer, the poker is placed at an angle against the rotation of the fuel bed. The top is stationary and the fuel bed rotates, and in the course of a few revolutions, the poker tip has covered the surface. This principle is also utilized in the Wood producer, which has one or two bent pokers, depending upon the size of the producer, which rotate, the tip making a circular path, the whole surface being agitated by the rotation of the fuel bed. The Morgan producer is equipped with a leveler, hinged in the stationary top; the fuel bed rotates. The Sheldon producer is equipped with two knives suspended from a rotating top. The knives are lifted and fall down, slicing the fuel bed. The stroke can be regulated. In the course of one revolution of the top, the whole fuel bed is chopped up. The Smith mechanical producer has a rotating top with swinging, steam operated plungers, which poke holes into the whole surface of the fuel bed.

The automatic agitation of the ash zone is a comparatively late addition to the mechanical producers in the United States. It has been proven that good gas at much higher rates of driving can be made thereby, and it is certain that more general use is going to be made thereof. In the Chapman producer, there is a horizontal casting, made in the shape of a bar, located in the water seal. This is attached to a gear ring above the water seal. The bar is equipped with short vertical lugs, which lift the ashes slightly when it rotates slowly. The bar also forces the ashes out towards the circumference, where they are automatically removed. The old Hughes producer did not have ash zone agitation, as the ash pan and shell were built together. In the new producer, however, the ash pan is not connected with the shell. The ash pan and the blast hood rotate with the producer by friction from the ashes. These parts are automatically stopped at short intervals, creating a twisting action at the bottom of the ash zone. The blast hood is shaped like a triangle or a hexagon, with rounded corners. This sets up a crushing action in the ashes in the plane of the hood, when the pan stops. In the Kerperley producer, the blast cone is located slightly eccentric in relation to the producer. The ash pan with the hood, rotates slowly, creating a twisting and crushing action in the ash zone. The Morgan producer has a spiral in the bottom of the rotating ash pan. This spiral can be stopped at will by the operator and discharge the ashes. The wood producer has scrapers attached to the rotating shell and the ashes are automatically removed continuously. The Smith mechanical producer is not equipped with water seal, as are most other types. Instead, there is a brick-lined cone, closed by a gate. The ashes are removed from this cone from time to time.

In addition to these producers, there are a few other types introduced in this country, or about to be introduced. A producer, similar to the Wood, is manufactured by the United States Cast Iron Pipe & Foundry Company, Philadelphia, Pa. The Duff Patents Company, Inc., Pittsburgh, Pa., is introducing a producer with arms extended from the rotating center of the top. These arms have fingers which de-

scribe circular paths in the fuel bed. The Gas Producer & Engineering Corporation of New Jersey, of New York, are introducing the Galusha producer. It is equipped with a vertical shaft, which extends from the driving mechanism on top of the producer through the fuel bed and the horizontal grating. To this shaft are fastened two flattened horizontal bars, which move in spiral paths, caused by the rotation and raising and lowering of the shaft. Both the ash and fuel zones are broken up by these bars. The construction is similar to the Talbot producer, introduced some 25 years ago in England. The Galusha producer uses a similar method for ash removal as the Smith mechanical producer.

The average dimension of the mechanical producers are 8 ft. and 10 to 10½ ft. diameter inside the brickwork. In one exceptional case, however, the diameter is as much as 16 ft.

Summary.

1. Laboratory tests of the balance between air, CO_2 , H_2O and C have hitherto been conducted under conditions so different from the conditions in the gas producer that such tests cannot be applied to the gas producer.
2. Balance diagrams of the two systems CO_2 , CO , C and H_2O , H, CO , CO_2 , C have been worked out which are applicable to gas producer practice.
3. By application of the laws of thermo-chemistry to these diagrams, conclusions are effected embracing all the factors that play a part in coal gasification.
4. The results obtained are compared to actual gas producer practice and check very closely with the best results obtained with both coke and bituminous coal.
5. A simple method is given for comparing the quality of the producer gas from practice with theoretical gas.
6. The influence of the temperature of gasification is discussed and it has been shown that a temperature between 2000 deg. and 2200 deg. F. gives the highest producer and combustion efficiency of the gas.
7. The gas made at 2000 deg. F. from ordinary bituminous coal should show the following analysis by volume of dry gas (H_2O and tarry vapors not included): C_2H_4 , 0.6; CH_4 , 3.6; CO , 29.1; H_2 , 13.3; total combustibles, 46.6; CO_2 , 3.4; N, 50.0.
8. Producer efficiency is discussed and a basis given for the calculation thereof.
9. Hot raw gas versus cold clean producer gas is discussed. In open hearth practice hot raw gas is a necessity. For small heating furnaces spread over a large area, clean gas has certain advantages.
10. The ash fusing producer is discussed. The efficiency of this producer cannot be expected to be as high as that of the ordinary producer, except under special conditions, and it is improbable that it will come into more general use.
11. The temperature of the gas from the producer is discussed. It is shown that on each fuel there is a certain low temperature which indicates that the condition of gasification is correct and that the fuel bed is uniform and free from blowholes. When this temperature is exceeded, the quality of the gas is reduced. This temperature is about 1100 deg. F. for western high moisture, high volatile coal and about 1200 deg. to 1300 deg. F. for eastern gas coal.

12. The influence of the temperature of the blast is discussed. The temperature should not exceed 131 deg. F. and in most producers it should be 2 to 4 deg. lower.

13. The use of oxygen in gas producers is discussed. Very high efficiencies can be obtained therewith, but in steel works practice the cost of oxygen must be lower than 30 per cent of the cost of coal to show a saving. With oxygen it is possible to make so-called "city gas" and transfer nearly all the heat in the coal into calorific heat in gas.

14. Rates of gasification are discussed. Rates as high as 50 pounds of coal per square foot per hour are possible in modern mechanically operated producers, with ash zone agitation, on both eastern and western bituminous coals.

15. Instruments required for controlling and supervising the operation of gas producers are discussed. It is shown that a pyrometer for measuring the gas temperature is the most important instrument and that with a recording pyrometer gas analyses are not required. The instrument next in importance is a thermometer for measuring the blast temperature.

16. The influence of preheated blast is discussed. Higher producer efficiency can be obtained thereby, but the heat required must be derived from waste heat in order to obtain economy.

17. It is pointed out that great savings in operation can be effected by using waste heat to supply the moisture in the blast. Even if waste heat boilers are used with the open hearth furnace, the waste gases contain sufficient waste heat to produce this moisture.

18. Waste gases, as a cooling medium in producers in place of moisture is discussed. Waste gases with a lower ratio of N to CO₂, do not contain sulphur, and constitute therefore an ideal source. With the use of waste gases, the producer gas will contain CO instead of H₂, which is desirable for open hearth furnaces. Higher producer efficiency than that obtained by the H₂O cannot be expected, except with preheated waste gas blast.

19. The use of blast furnace gas as a cooling medium is discussed. In this relation there are two outstanding factors, (1) the substitution of 15 to 20 per cent of the coal fuel by heat in the blast furnace gas results in a fuel lower in sulphur, a desirable factor in open hearth operation; it also permits the use of a higher sulphur coal. And (2) the efficiency obtained is high and the heat in the blast furnace gas is transferred into a high grade fuel that can be used in open hearth furnaces.

20. The savings possible with waste gases or blast furnace gas are discussed. Practically all of the steam cost under present practice and prices, 35 to 70 cents per gross ton of coal, can be saved.

21. A short description of modern mechanical producer types is given.

H. A. Berg, general manager of the Marting Iron & Steel Company, Ironton, Ohio, has resigned to become associated with Arthur G. McKee & Company, engineers and contractors, Cleveland, Ohio. Mr. Berg is one of the foremost blast furnace operators in the industry. Following years of experience at Carrie Furnaces, he joined A. A. Corey, Jr., as superintendent at Cambria Steel, going from there to Ironton.

Operation of Open Hearth Furnaces

By ULRICH PETERS

The operations of open-hearth furnaces in the past, present, and eventually in the future, will show irregularities as to endurance and heat economy regardless of all the practical improvements conceived, evolved and applied, for the reason, primarily, that the life and tonnage production depends on the quality of the fuel supplied, the proper control of the heats, and on the resistance of the refractory materials. In other words, the variable factor of tonnage production goes a great deal with the ability and vigilance of the melter, who is driving and nursing the furnaces as much and as best he can. Conditions, such as clogged checkers, defective bottoms and ports and a crumbling roof arch demand periodically a complete shutdown for repairs.

For comparison, the tonnage records of two furnaces are here given,—both were oil-fired and otherwise alike in every respect as to life and details of constructions:

O. H. Furnace	No. of Heats	Tons Melted	Days Run	Cost on Repairs and Bottom	Repair Cost per Ton
E	334	18,376	132 74	\$21,278	\$1.157
D	154	7,604	81 60	20,094	2.643

These furnaces, E and D, have been picked out from a group of five 50-ton furnaces,—Furnace E showing the best and Furnace D the worst performance of a run under the charge of the same melter. The great deficiency in tonnage of the D furnace over the E furnace amounts to nearly 12,000 tons per year pro rata taken, representing a financial loss or opportunity to a waiting market. From the other viewpoint, the operating expenditures, based per ton, pile up as follows:

		Cost per Ton O. H. Ingot			
O. H. Furnace	Fuel	Wages, Mch. and Ladles	Furnace Repairs	Depreciation Fixed Charges	Total Cost
E	\$1.95	\$3.25	\$1.157	\$1.05	\$7.407
D	2.75	2.85	2.643	1.60	9.843

In the above accounting, we note that the difference in the total costs of operations equals to \$9,843 — \$7,407 = \$2,436, and that this additional cost of operating such bad furnaces would equal the total cost of the fuel utilized.

The American Electric Power Company has recently awarded contract to the U. G. I. Contracting Company, of Philadelphia, for the remodeling of the Carburetted Water Gas Apparatus at the plant of the Carbondale (Pa.) Gas Company. These improvements will greatly increase the facilities of the Carbondale Company for serving its territory.

John F. Gaffney, for several years in charge of foundries for the Bethlehem Steel Company at Sparrows Point, Md., and for the Allis-Chalmers Mfg. Co., Milwaukee, has been employed as superintendent of the foundry for the Hadfield-Penfield Steel Company, Willoughby, Ohio.

Thomas Vickers, C.E., late of the British Cast Iron Research Association, has commenced in private practice as a foundry consulting engineer with offices at 14 New Street, Birmingham, England.

Influence of Ore Size on Reduction¹

Conclusion of Most Exhaustive Series of Investigations Surrounding the Experimental Blast Furnace of the Bureau of Mines

By P. H. ROYSTER², T. L. JOSEPH³ and S. P. KINNEY⁴

AN effort was made during the experiments with the Bureau of Mines' blast furnace at Minneapolis to determine the composition of the gas stream at various points in the furnace shaft. It was hoped such data would afford means of following the course of the reactions taking place in the furnace. Altogether about 600 samples of gas were collected, these being taken with a water-cooled tube driven into the charge column through five test-holes built in the shell and brickwork of the mantle. The test-holes were respectively 13, 42, 71, 100, and 129 inches below the stock line. The sample tube was long enough to cover the complete diameter of the furnace at these five elevations. The position of the test-holes and the results of one series of gas samples were shown in Fig. 4 of the paper in the May issue of this journal⁵. For convenience of reference, this figure has been reproduced here as Fig. 1, and the furnace operation described in the four preceding articles is designated in this paper as Test A. The 47 gas analyses, used in constructing this drawing, were given in Tables IV to VIII of the May article. The purpose of the present paper is briefly to summarize the remaining 565 analyses, and to direct attention to some of their more obvious features.

Furnace Operation with Sized Ore.

It seems to be true that the physical properties of iron ore, and particularly its most obvious physical property — size of particle — have an important effect on the blast-furnace process. This fact is appreciated by certain Eastern operators who are having experience with ores, the characteristics of which have changed in recent years. It will also be recalled by consumers of Lake ores who have not forgotten the difficulties encountered when Mesabi ore was introduced into American practice. To the writers, whose task it has been for some years to collect and study operating data from a wide variety of practices, representing a number of iron-making districts of this country, the importance of ore size has always been most evident. It was inevitable, therefore, in initiating the present experiments that attention should have been given to the size of the particles constituting the charge. A general description of the size of the ore, coke, and limestone used in Test A was printed in January⁶. In other experiments to be discussed in

this paper, the size of the coke and limestone remained unchanged. The size of the ore, however, was altered in the several tests, and it was found that a marked change in the operation of the experimental furnace resulted. The composition of the metal and of the slag changed, and a glance at the six diagrams (Figs. 1 to 6) accompanying this paper will show that the size and shape of the so-called inactive zone also changed.

It should not be forgotten that the results already published were attained with a particular furnace and with sized ore, limestone, and coke, as was described in January. The size of particle of the materials in the charge was as much a part of the design as was the hearth diameter, the bosh angle (74 deg. 56 min.), or the height of the furnace. There is evidence that with some other combination of fuel and flux sizing different results might have been attained. The writers are not suggesting that the sizing of material is desirable in regular practice, but they are presenting this set of seven rated experiments simply as a contribution to present knowledge of the mechanism of ore reduction, leaving it to the reader to apply them, if he thinks them applicable, to any practical problem that interest him.

Operation with Medium Size Ore.

All of previously reported results were obtained from furnace operation designated here as Test A, in which the ore used was of "medium size". There seems to be neither a term in common usage nor an accepted method of calculating an index number or a label to designate size of irregular particles⁷. If the indefinite adjective "typical" is permissible, it can be said that the typical lump was $\frac{1}{2}$ in. long, $\frac{3}{8}$ in. wide, and $\frac{1}{4}$ in. thick. If the ore had passed through a shaking screen with a 0.47-in. square opening, and had been caught on a second screen with a 0.33-in. opening, the resultant product would have been about as uniform and would have the same average particle size as the material actually used. This medium size ore in bulk contained from 15,000 or 20,000 particles or lumps to the cubic foot, the uncertainty in the estimate being due to a doubt as to the proper method of taking an average. The expression "lumps per cubic foot" seems the most convenient method of recording ore size, but unfortunately it is not a term that has been used previously, and therefore will mean little to the reader.

Fine Ore Test.

All the iron ore used in Tests A, B, C, D, and E, came as a single shipment from one mine. The structure and chemical composition of all the ore, so far as could be ascertained, was essentially the same. In Test B the ore was partly dried, and passed through

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⁵P. H. Royster, T. L. Joseph, and S. P. Kinney, "Time Element in Iron Ore Reduction", *The Blast Furnace and Steel Plant*, vol. 12, May, 1924, pp. 246-250, and 254.

⁶P. H. Royster, T. L. Joseph, and S. P. Kinney, "Reduction of Iron Ore in the Blast Furnace", *The Blast Furnace and Steel Plant*, vol. 12, January, 1924, pp. 35-37.

⁷G. St. J. Perrott, and S. P. Kinney, Meaning and microscopic measurement of average particle size: *Journal, American Ceramic Society*, vol. 6, 1923, pp. 417-439.

a stationary screen with a $\frac{1}{8}$ -in. opening. A sieve test on this fine ore gave the following results:

Screen No.	Per Cent
+ 8	0.4
+ 14	6.0
+ 28	20.4
+ 48	35.4
+ 65	14.5
+ 100	8.9
- 100	14.4

The lines of equal CO_2 content for Test B, shown in Fig. 2, have the same general shape as those in Fig. 1. The maximum CO_2 , however, is quite high, so much so that it is probably worth while giving the complete analysis of the gas in the plane 13 inches below the stock line:

Sample No.	Distance from left wall, Inches	Per cent by volume.				Ratio CO_2/CO
		CO_2	CO	H_2	N_2	
434	0	10.8	25.0	1.4	62.8	0.43
432	12	21.0	13.8	2.7	62.5	1.52
431	19	19.0	14.3	3.1	63.6	1.33
430	21	20.8	15.6	3.9	59.7	1.33
429	26	10.0	26.0	2.3	61.7	0.39
428	31	7.5	28.2	1.9	62.4	0.26

The analyses are sufficiently unusual to be of interest, particularly to those who are accustomed to judging the efficiency of reduction by the ratio CO_2/CO found in the gases at the furnace top. Unless samples 430, 431, and 432 are completely in error, any attempt to defend Bell's theory⁸ of the limited reducing power of CO must be abandoned. His prediction that the ratio cannot exceed 0.4 to 0.5 is evidently unjustified. On the other hand, it should be noted that a high CO_2/CO ratio is found only on a small part of the stock-line area. It is difficult to say which is the more striking feature of the analyses tabulated above; the high CO_2/CO near the center, or the large variation in this ratio at different points on the same horizontal section of the furnace. The first indicates the great intensity of reduction which is chemically possible, and which might be attained in a properly designed furnace; the other shows how improperly this furnace was designed.

No hanging or slipping occurred in the shaft with fine ore. The pressure at the tuyeres did not increase; on the contrary, it was somewhat less than in Test A. The ore reached the tuyeres, however, in an incompletely reduced state. This caused a clogging effect in the hearth and in the combustion zone which made it necessary to take the fine ore burden off, and some care had to be exercised in handling the furnace, or the success of the campaign would have been jeopardized. The metal made on this burden was high in sulphur and its accompanying slag was black and scouring showing several per cent ferrous oxide.

Experiment with Coarse Ore.

It having been found impracticable to operate on the fine ore, in spite of the promising indication of rapid reduction in the shaft, a coarse lumpy part of the ore was used. The number of ore particles in Test A was say 20,000 per cubic foot. In Test B, the fine ore consisted of some 50,000,000 particles per

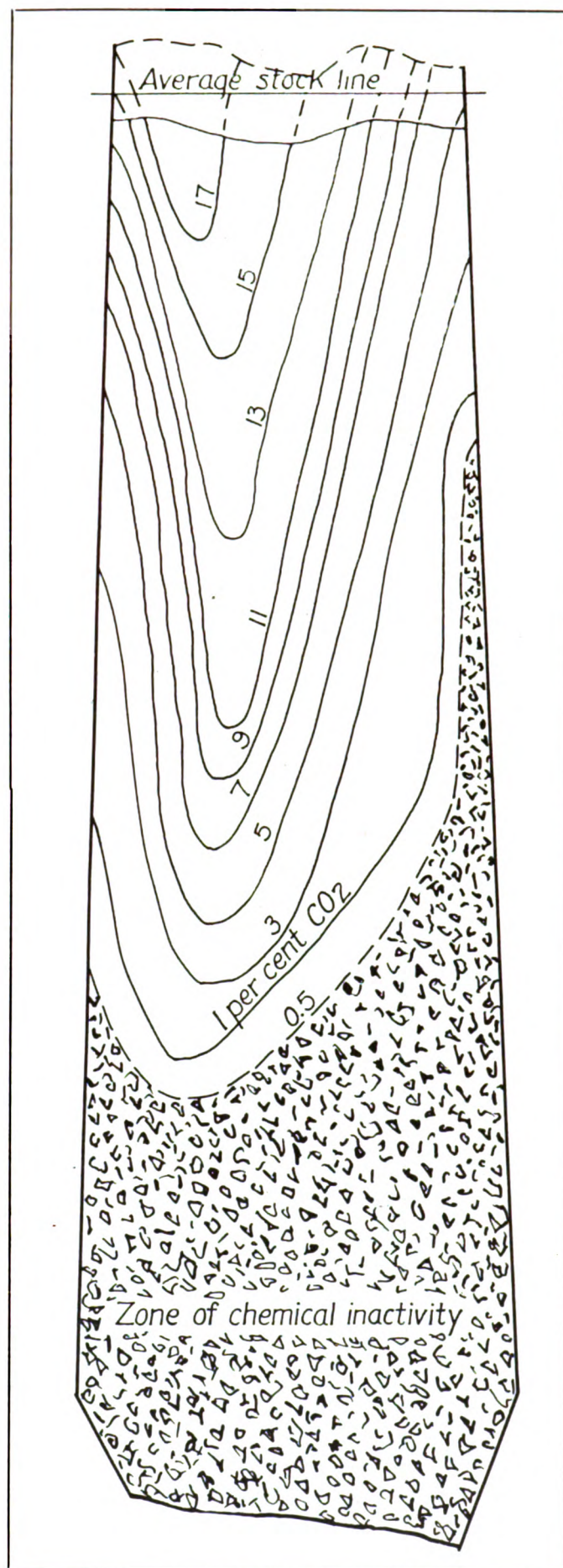


FIG. 1.—Medium size iron ore—Test A.

⁸I. L. Bell, Chemical Phenomena in Iron Smelting; 1872.

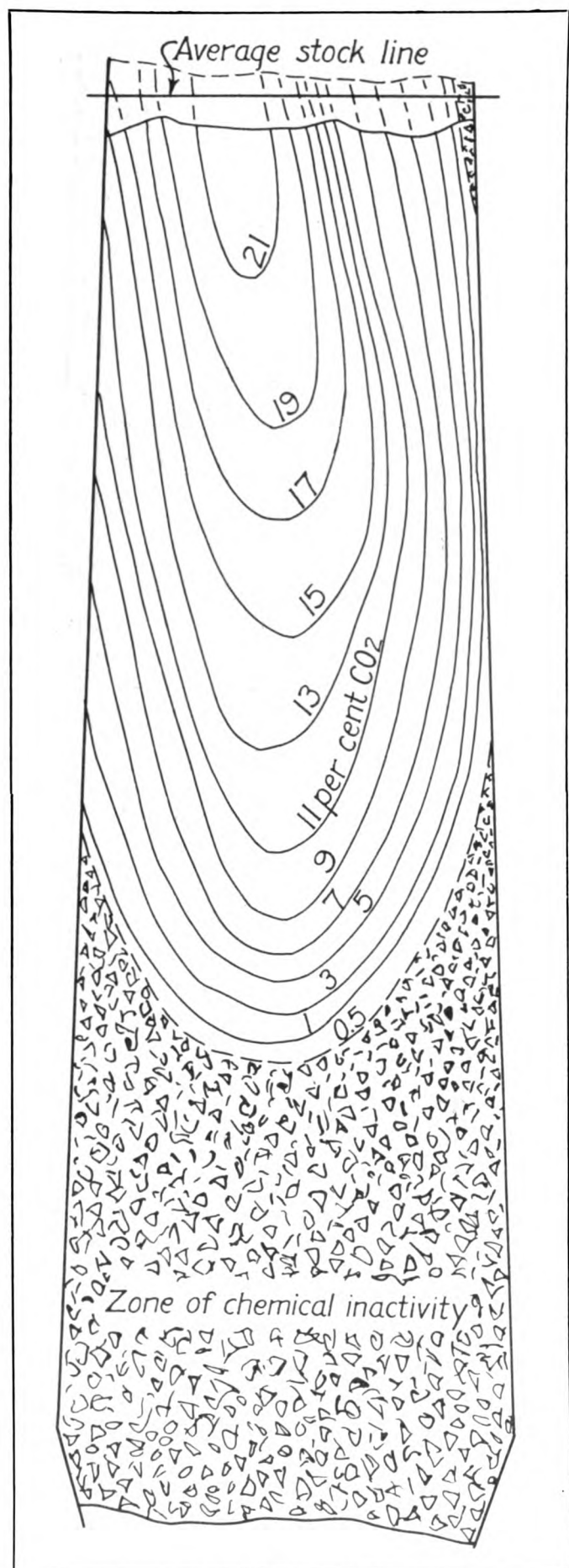


FIG. 2.—Fine ore—Test B.

cubic foot. The lump ore used in this third experiment, Test C, averaged 1,650 lumps per cubic foot, and the ore lump was therefore "on an average" about the size of the nut coke used. The so-called typical particle of this coarse ore was $1\frac{1}{2}$ in. long, 1 in. wide, and $\frac{1}{2}$ in. thick. It was not as uniform in size as the medium ore of Test A, although it was much more uniform than the fine ore of Test B.

The gas composition in the furnace shaft during Test C is indicated in Fig. 3, and an analysis of the top gas is given in Table I. The hearth products were again high-sulphur white-iron metal and a black scouring slag. No mechanical difficulties were experienced in handling the furnace, operation being, if anything, less difficult than in Test A. The temperature of the slag and metal was noticeably lower, the average slag temperature being 1473 deg. C. for Test C, compared with 1529 deg. for Test A⁹. The off-grade metal made showed an average composition of 2.48 per cent, Si, 0.80 per cent, S, 0.32 per cent, Mn, 0.65 per cent, and P, 0.17 per cent. The sulphur in the metal wandered erratically from 0.125 per cent to 0.432 per cent. The slag analyzed about 2 per cent of iron as FeO, and carried off an appreciable amount of metal as shot. Throughout Test C the furnace had all the symptoms of a "cold hearth".

TABLE I. — Average Composition of Blast-Furnace Top Gas for Six Tests.

Test	Ore used	CO ₂	CO	H ₂	N ₂	CO ₂ /CO
A	Medium size...	10.17	24.93	1.31	63.59	0.41
B	Fine ore.....	8.18	26.50	1.65	63.67	0.31
C	Lump ore	8.79	27.61	1.53	62.07	0.32
E	Lump: Light burden	8.68	26.61	1.88	62.83	0.33
F	Manganiferous, medium	7.63	29.28	1.67	61.42	0.26
G	Manganiferous, lump	7.16	25.50	2.05	65.29	0.28

In common parlance, the furnace operated "smoothly" in Test A; it was "stuck up in the bosh" in Test B, and in Test C it was "cold in the bottom" and "overburdened". In point of fact, the chemical composition of the charge was the same throughout, and the burden in each of the three tests was the same — namely, 145 lb. of ore, 50 lb. of limestone, and 120 lb. of coke per round. The changes in the operation of the furnace must therefore have been due solely to changes in the physical properties of the ore. The easiest explanation would be to say that the fine ore was too fine, the coarse ore too coarse, and the medium ore just right. Such an explanation is consistent with the facts, but it is not comprehensive. The true explanation may not depend on the inherent size of the particles. The size of the particles of medium ore and of coarse ore is of the same order of magnitude, but differs widely from that of the fine ore. If therefore the absolute size of the particle was the dominant factor in the rate of reduction, it would be expected that Figs. 1 and 3 would more nearly resemble each other than would Figs. 1 and 2, but the reverse of this is found to be true.

Homogeneity and Absolute Size.

There is an element other than average particle size which may be of importance. This is homogeneity.

⁹P. H. Royster, T. L. Joseph, and S. P. Kinney, Significance of Hearth Temperatures; *The Blast Furnace and Steel Plant*, vol. 12, March, 1924, p. 158, Item 10, Table IV.

ity or uniformity of particle size. A variation in size from one ore lump to another in a given round will lead inevitably to a non-uniformity in the flow of gas. Some ore particles will be in a strong current, others will be more or less shielded from the gas stream. The sheltered particles will reach the hearth inadequately reduced. Their oxidizing effect will interrupt the proper course of the desulphurization process there, and produce just exactly the results actually found in Tests B and C. To throw some light on this problem, the following experiment (Test D) was carried out:

The coarse ore was thrown on a $\frac{1}{2}$ -inch grizzly, and from the grizzly oversize the large lumps were removed by hand picking. The residue was first charged, and then the lumps removed by hand were sorted into three sizes and charged in their turn. Then the portion passing through the grizzly was re-screened on a $\frac{1}{4}$ -inch screen and charged. This process was laborious, and only enough hand-picked ore was obtained to last six hours. Nine hours after this ore was charged the furnace began making grey iron in place of the white iron of Test C. The slag temperature rose to an average of 1562 deg. C. The fracture of the slag sample was almost perfectly white, and analysis averaged 0.39 per cent FeO.

The results obtained are presented here somewhat hesitantly; they are offered because they seem too important to suppress, and yet the writers realize that they are far from conclusive. At best they may be said merely to hint at a metallurgical conclusion. The evidence suggests that within reasonable limits uniformity of particle size in a given round has more effect upon the rate and completeness of reduction than does the absolute size of the average particle. The test was so short, however, that such a conclusion may be quite erroneous. Its effect at least is to warn the reader not to ignore uniformity of lump size, in any discussion of the effect of ore size on reduction in the blast furnace.

Coarse Ore with Higher Fuel Ratio.

The results of Test C show that smelting operations with lump ore were unsatisfactory. It appears from Test D that an approach to satisfactory operation can be realized by classifying the lumps, segregating them, and charging the different sizes into the furnace in sequence. Presumably there are a number of other suitable modifications in procedure which will accomplish the same result. In Test E, for example, an increase in the coke ratio restored the chemically idle zone to its normal position, as will be readily seen from Fig. 4. During Test E, the burden was 115 lb. of lump ore, 50 lb. of limestone, and 120 lb. of coke per round. The composition of top gas with this burden is given in Table I. The metal made was grey iron, high in sulphur, the average analysis being C, 3.16 per cent; Si, 1.19 per cent; S, 0.118 per cent; Mn, 1.64 per cent, and P, 0.15 per cent. The hearth was probably not so strongly reducing as in Test A, and desulphurization of the metal was not complete. The slag was reasonably iron-free, averaging 0.9 per cent iron as FeO. Tests C, D, and E, taken together, show that an increase in coke neutralized the bad effects of an unsuitably sized ore. The 800 lb. of additional coke of Test E accomplished the same result that the improved sizing seemed to accomplish in Test

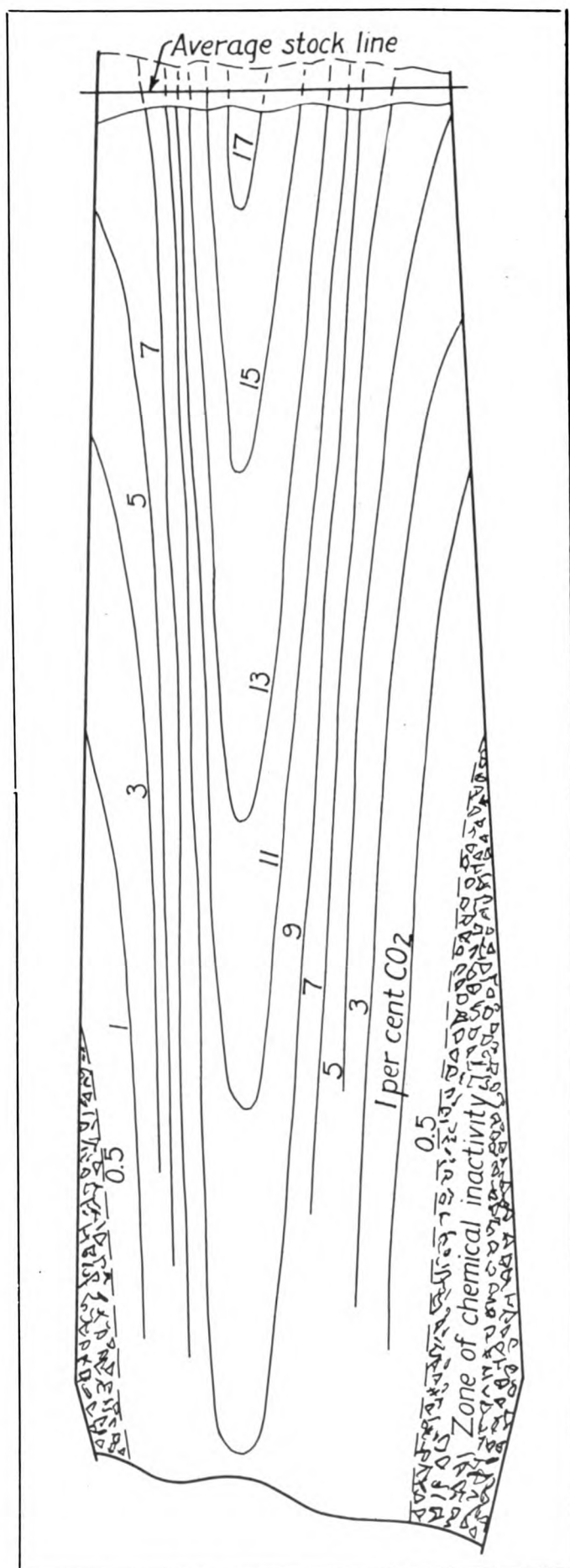


FIG. 3.—Lump ore—Test C.

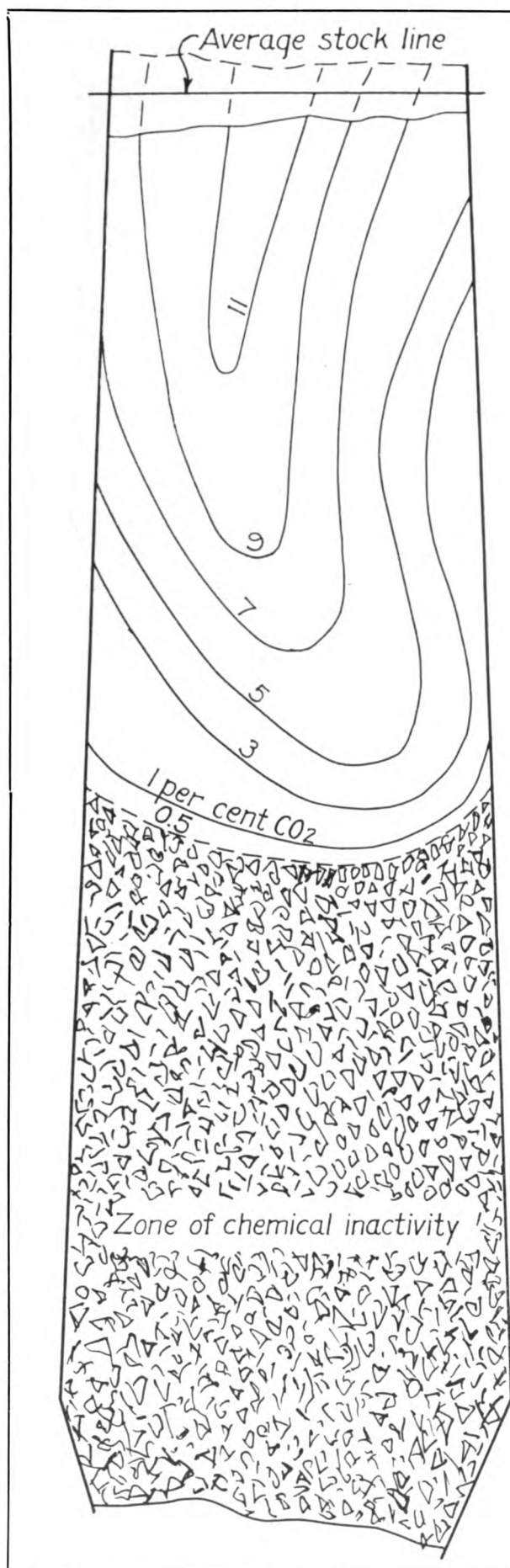


FIG. 4.—Lump ore with high fuel ratio—Test E.

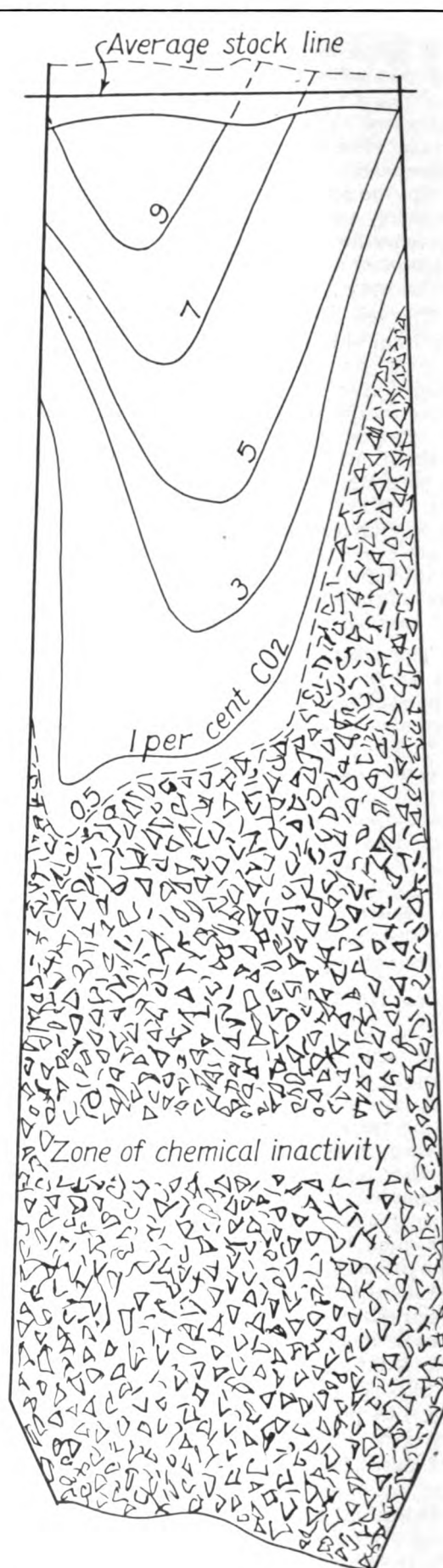


FIG. 5.—Medium size mangiferous iron ore—Test F.

D. The three tests indicate how a relationship may be developed connecting fuel consumption and the size of the ore particles.

Experiments with Manganiferous Iron Ore.

It seems appropriate to incorporate in this paper the results of two experiments with manganiferous ore from the Cuyuna Range. The chemical composition and mineralogical character of the ore are supposed to have an effect upon the rate of reduction, and therefore upon the position of the reduction "zone" in the blast furnace. In Test F, the Cuyuna ore was sized to correspond somewhat to the medium size ore of Test A. Although the ore in Test G was lumpy, the size of the average lump was smaller than in Tests C, D, and E. The analysis of the manganiferous ore was Fe, 31.6 per cent; Mn, 21.0 per cent; SiO_2 , 6.98 per cent, and Al_2O_3 , 4.18 per cent. The burden in Test F was 135 lb. of medium size Cuyuna ore, 40 lb. of limestone, 15 lb. of dolomite, and 120 lb. of coke per round. In Test G, the burden was 135 lb. of lump Cuyuna ore, 50 lb. of limestone, and 120 lb. of coke per round. The composition of the top gas for the two tests are given in Table I. The position of the CO_2 lines in the furnace shaft for Test F is given in Fig. 5 and for Test G in Fig. 6. Reduction takes place well within the upper half of the mantle in Fig. 5. In Fig. 6 there is evidence that a slight increase in burden, or an increased irregularity in the lump size would cause the reduction zone to descend into the normally inactive zone with the result that Fig. 6 would resemble Fig. 3. The metal made with this ore was somewhat variable, particularly in regard to manganese content. The average analysis obtained indicated the following composition: C, 4.42 per cent; Si, 1.20 per cent; S, 0.022 per cent; Mn, 10.8 per cent, and P, 0.59 per cent. The rather incomplete data on manganiferous ores in the experimental furnace are given here since it is of interest in connection with the iron ore tests; the study of this type of ore is being continued.

Conclusion.

The details of the sample-tube method of determining the zone of reduction in the blast-furnace shaft were described in the preceding article of this series, and in the present paper, data from a group of seven tests is given. During these seven tests only three operating quantities were changed, the character of the ore (Mesabi hematite and Cuyuna manganiferous), the size of the ore (coarse, medium, and fine), and the fuel ratio. In each test the size and chemical analyses of the coke and limestone, the rate of driving, the blast temperature, and furnace lines were constant throughout. The six diagrams accompanying this paper throw considerable light on the details of the reduction-reactions, and the writers have found them well worth studying. Aside from their intrinsic value, these tests are of interest as an illustration of the kind of problems which can be investigated with such a piece of laboratory equipment as an experimental blast furnace. With a full-size furnace the sample-tube method of studying blast-furnace reactions yields similar results, although the time and effort required to get the same amount of information is increased manifold, and little hope is entertained of collecting such data for a group of related operations on the same furnace.

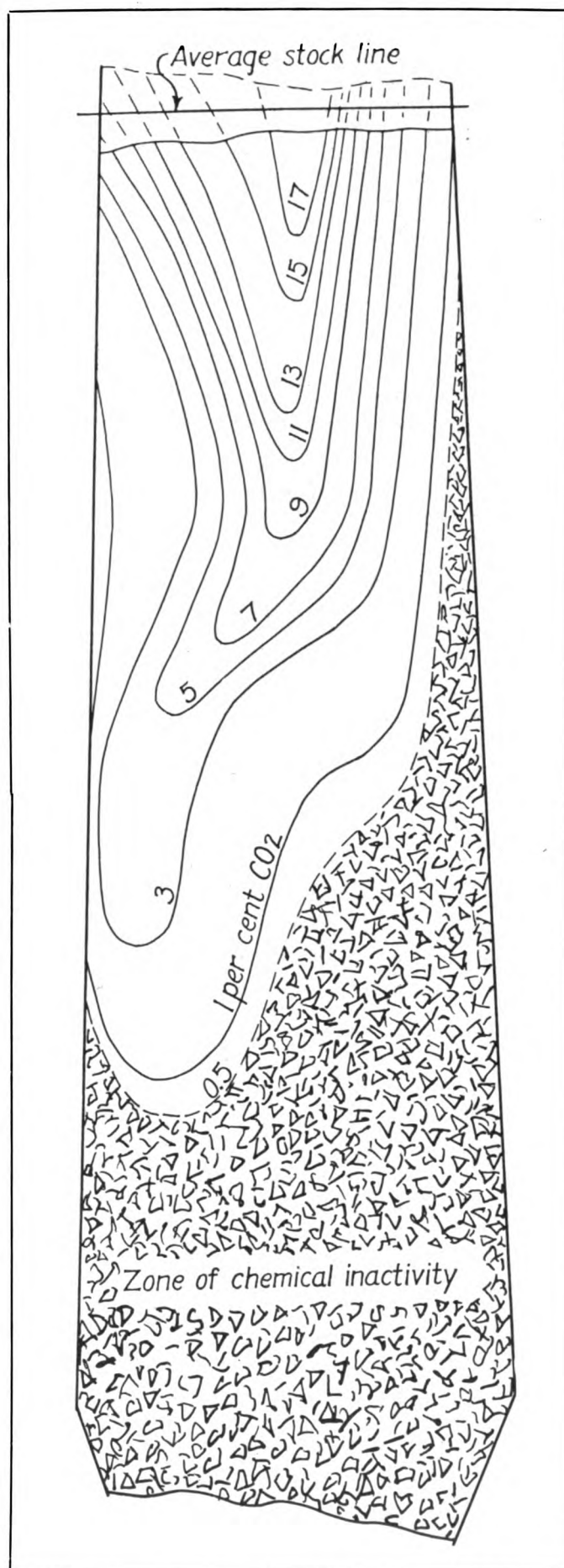


FIG. 6.—Lump size manganiferous iron ore—Test G.

One of the present writers believes the continuation of the experimental furnace work is the most promising method of studying blast-furnace phenomena; another believes that the field work at industrial furnaces is the best line of attack; while the third thinks that a more thorough study of the fundamental reactions in a purely scientific laboratory manner is of more practical value. All three writers, however, agree that these various methods of study are of value, and the research will be continued along these three channels, as rapidly as opportunity permits.

Acknowledgements.

The writers are unwilling to conclude this series of papers without some reference to the assistance they have received from members of the Bureau of Mines and of the University of Minnesota. In the first place, this research would have been abandoned years ago had it not been for the unfailing confidence and continued encouragement of the chief metallurgist and assistant director, Dorsey A. Lyon. To no less extent, the progress of this work is indebted to the advice and co-operation of C. E. Julihn, past superintendent of the North Central Experiment Station, and to William R. Appleby, Dean of the School of Mines, University of Minnesota. The list of those at the University and in the Bureau who have helped in the work is too long for publication, but some reference must be made to the interest, practical advice, and active assistance of Peter Christianson, professor of metallurgy in the School of Mines.

Blast Furnace Practice

By MARK MEREDITH

The iron and steel industries account for the consumption of a considerable amount of coal per annum, probably of some 30,000,000 tons. For a long time it has been suggested that the portion used in the blast furnace has been near the border line of irreducibility. Sir Lowthian Bell set this figure at 20½ cwt. of coke per ton of pig iron from a Cleveland ironstone yielding 41 per cent of metal, and but a few years ago a fuel economy committee of the British Association still represented this figure as the practical minimum.

The subject is an attractive one for research, and some time ago Messrs. E. R. Sutcliffe and E. C. Evans gave to the Iron and Steel Institute convincing indications of possible economies. There are, for example, several factors which may considerably influence fuel consumption. These include design of furnace and the character of the material used, such as ore, limestone, air blast, and coke. It is, however, mainly with the fuel that the authors are concerned. This is required for two purposes, chemical reduction and thermal effects.

For a long time certain definite qualities in furnace coke have been regarded as very desirable and were therefore sought for. These were freedom from sulphur, high carbon content, porosity, and resistance to abrasion. These qualities are above criticism, but it was further required that the coke should be resistive to the action of carbonic acid in the upper part of the furnace, an action which the authors now advocate as distinctly advantageous rather than detrimental. For a long time the solubility of carbon in car-

bon dioxide has been regarded as deleterious to fuel economy. It has, for example, been found that the solubilities of charcoal, coke and anthracite in carbon dioxide are in the order named, and yet the practical superiority of charcoal is well recognized. The matter undoubtedly calls for research and admits of discussion.

The problem seems to center around what has been called the reactivity of coke as measured by its power of reacting with oxygen or with carbon dioxide. This constitutes a measure of the combustibility of coke. This, according to the authors, is not so much dependent upon the percentage of volatile matter in the coke as on its structure. A coal can be carbonized at any temperature and by any system and, with due care to obtain a certain characteristic structure, an extremely high degree of combustibility will result.

Such a fuel lowers the zone of reduction on the furnace and enables the reactions to be carried out at a much higher temperature than with ordinary coke. The output of a furnace increases with the rapidity with which the fuel is consumed.

It is possible to make estimates of the quantities of the coke required on the assumption that the furnace reactions proceed along definite lines, which are within the range of possibility. Against the usual consumption of, say, 21 cwt. coke per ton of pig iron, cases in which a much reduced quantity has been used can be quoted. One of the 11 cwt. per ton of pig iron was reported by Bell. If reduction can be effected by a lower proportion of carbon monoxide to carbon dioxide than usual, and if some of the carbon can be reduced by carbon then considerable savings of fuel are possible, and it appears probable that a highly active fuel of the type described opens up far-reaching possibilities in blast furnace practice, and long established views of experts with reference to fuel economy in the smelting of iron may have to be reconsidered.

While we have been publishing a series of highly technical articles on the operation of the blast furnace, by members of the Bureau of Mines staff, our esteemed monthly, *The Scientific American*, has been printing a popular series entitled, "The Story of Steel." Its fourth number, that in the April issue, concerns the blast furnace. In this is shown diagrammatically the operation of a furnace and its accompanying stoves and accessories. For the purpose of informing the scientifically inclined portion of the public we consider these popular articles of real value, and of course they are correctly presented.

Birmingham, Ala., is to be the meeting place for the American Institute of Mining and Metallurgical Engineers during October. We understand that some particularly interesting papers have been and are being prepared for this meeting, especially pertaining to furnaces and mining ore. That district mines 10 per cent of our total iron ore and produces 7 per cent of the pig iron of the country.

Further mention of foreign fields might include the progress of the Tata Iron & Steel Company in India. As is well known, much of this work was made in America. Recently a fifth blast furnace was blown in. This is the second of 600 tons capacity, and two more are contemplated. At present the daily capacity is 2,000 tons of pig iron.

*Liverpool, England.

Böhler Steel

A Thriving Industrial Vestige of Dismembered Austria

By HENRY OBERMEYER and ARTHUR L. GREENE

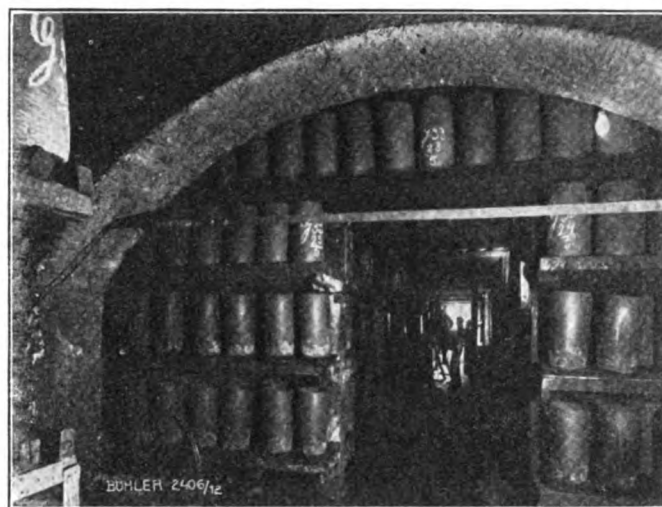
AUSTRIA has been so severely stripped of her industries, natural resources, population and other elements of her former wealth that she is scarcely expected to be included any more as one of the industrial nations of Europe. Nearly all her big textile, sugar and glass factories as well as her former coal deposits are now in Czecho-Slovakia, and as a general rule there can be said to be little love lost between the two. On the other hand, the few machine factories which Austria has retained, especially three or four locomotive works, which formerly supplied all the railroads in the great dual monarchy and who now find their market suddenly limited to a state only a fraction of the size of the old, have shrunk to an extent which is only a step or two removed from total extinction. That, under these circumstances, there should still exist in Austria an industrial firm in comparatively flourishing circumstances is a cause both for wonder and explanation. Hence this account.

Böhler Brothers & Company, manufacturers of quality steel, are not unknown outside of Austria. In fact, they are rather better known outside than in. Domestic trade is but a small part of their total output—approximately a third—and represented about the same percentage before the war as now. Backed by a tradition literally of centuries they have considered it worth while to devote their entire production to a branch of the steel industry which is admittedly too slow, too complicated and too restricted to claim much time or attention from the big iron and steel corporations of Europe and America. The consequence is that Böhler Brothers now have the world for their market. They are specialists with what might be called a unique place in the industry. While other manufacturers of steel, in Europe at least, are wondering where the next orders are coming from, Böhler Brothers keep their five factories working at an even, steady and remunerative pace.

As briefly as possible, Böhler products mean crucible steel at a dollar a pound including transport across the Atlantic, or four crowns (pre war gold) f.o.b. Kapfenberg. They mean a variety of fine steel tools, intricate forgings for the construction of machines and motor cars, switches and cross sections for street railways, plates and sheets of high speed steel and of transformer and dynamo plates, and other appliances to the intricacy and perfection of which there is no reasonable limit. They mean the old, cumbersome, expensive methods of hand labor and minute personal attention; of commission business and piece-work. In short the reverse of the principles of standardization and quantity production usually associated with prosperous, up-to-date steel mills whether here or abroad. And yet there is no other way thus far discovered by which Böhler products can be turned out for the market.

It is not that Böhler Brothers confuse the attributes of quality and quantity. Herr Otto Böhler, from whom the facts used in this article were obtained, is sufficiently acquainted with American steel produc-

tion to know that quantity production is not necessarily inconsistent with quality steel. Old fashioned hand methods, where employed in the Böhler plants, are employed because of necessity. If the manufacturer of rails, boilers and girders were to adopt the Böhler method the price of steel would become prohibitive; and besides, the quality would surpass the requirements. A steel corporation with hundreds of millions of invested capital cannot afford to devote its mills to the production of, say, steel for surgical instruments. That is the place Böhler Brothers have made for themselves. They won their success because they avoided competition as far as that was possible. They are operating today, in spite of adverse conditions in their own country and in foreign markets, because their product is a necessity.



Drying crucibles. The crucibles emerging from the presses are dried for about 5 to 6 weeks in heated and ventilated chambers. Permanent stock of 50,000 crucibles.

One is permitted a little curiosity over the affairs of such a concern as Böhler Brothers. Situated in a country which has literally fallen to pieces and the value of whose currency is second in fantastic worthlessness only to that of Russia, how are they able to carry on business as before? What handicaps have they met and by what methods have they managed to overcome them? Financing, raw materials and marketing are the bases of one's questions. One also wonders how, with the war and the consequent shortage of raw materials, especially in Austria, a manufacturer of quality steel has managed to maintain his standard. Obviously this is the most important question of them all.

First, however, one must examine the resources and the organization of the company. Briefly, Böhler Brothers own and operate five factories in Central Europe. The largest is in Kapfenberg, Austria. The second is in Dusseldorf, Germany, one of the principal centers of the Ruhr district now occupied by the French. The remaining three factories are all in Aus-

tria. The company's principal source of high grade ore lies in the Styrian Mountains, one of the few natural productive regions left to Austria, and consists of what is probably one of the most remarkable deposits of iron in the world. Here is an entire mountain of extraordinarily pure spathic ore, extracted entirely by open quarrying, of which, together with the Alpine Mining Company (Alpine Montan Gesellschaft) Böhler Brothers are the sole owners.

The equipment of the various factories, even of the newest in the Dusseldorf, which is less than 10 years old, may be described as conservatively modern. Böhler Brothers are not and cannot afford to be radicals in the development of steel manufacturing. A large output—quantity production—holds no inducement for them. They work for the comparatively few. Their sole concern is with the maintenance of a standard. Thus, while they are well equipped with those machines and furnaces which help to increase



Dredge buckets. The bucket lips are made of manganese steel of extraordinary resistance.

the quality of their manufactured steel, they have not extended themselves in the direction of mere labor or fuel saving devices. Pig iron is produced in small blast furnaces, converted into steel in open hearth, and remelted in electric and crucible furnaces. The big Kapfenberg factory is operated to within 50 per cent of its capacity on water generated electric power.

But there are many things, they say, which still cannot be done by electricity, such as the production of pig iron in electric blast furnaces as is being attempted in parts of Sweden. They are busily investigating the scientific problems that may lead to technical improvements, not wishing, however, to adopt a new process until it has proved as reliable as the old. Otherwise they prefer to rely on the methods of the past on which their reputation is based. In the manufacture of pig iron for crucible steel the factory uses only the highest grade charcoal instead of coke. Gas furnaces are operated only on pure coal. The labor that goes into the making of the steel is of the same high quality. Many operations are carried out by hand which in our steel mills are accomplished mechanically if not automatically. A great many of the laborers are descended from generations of steel workers who are said to have worked on the site of the Kapfenberg mill when it was one of the centers of the

guild. Parts of the old walls are still standing as sections of the new.

We see, therefore, that change and readaptation does not come easy to a firm like this. This makes it seem all the more amazing that Böhler Brothers were able to pass through the strenuous days of war and the even more trying times of peace without apparently having its reputation, organization or even markets seriously impaired. The fact remains, however, that Böhler Brothers today employ approximately the same number of workmen as before the war — something more than 7,000 — who receive the same scale of wages, estimated on a gold basis, and who produce, in the main, the same variety and amount of products.

Even the distribution of sales has not materially altered, although the occupation of the Ruhr may be found to have effected a more or less temporary change. Up to that time one-third of the Böhler output went to Germany, one-third was sold in Austria or its former possessions, and the remaining third was distributed abroad, especially to the United States where the manufacture of high grade steel for machine tools, etc., generally gives way to production of structural grades. This distribution was substantially the same in 1914. The constant demand for this type of steel on the part of America is naturally owing principally to the cost of labor here which prohibits the employment of large numbers of workers for such enterprises. The turnover is too small and the yield of profits is too low.

One of the most notable features of the Böhler Company after the war was the rapidity with which the concern recaptured its markets in so-called enemy as well as neutral countries. The real answer to this, of course, lies in the fact that no serious attempt was made by any other company to capture it. This would have been difficult not merely because of Böhler's world-wide reputation but more directly because of its long years' of experience in the manufacture of a highly specialized product. In point of fact Böhler had regained at least a permanent foothold on its former markets within six months after the Treaty of Versailles.

Difficulties not inconsiderable had to be circumvented. Chief among these were the effects of the long, lean years of fighting during which there existed a virtual embargo of tungsten manganese and other elements required in the manufacture of Böhler steel which the company had been accustomed to obtain through the London market. With the resumption of peacetime activities there were very real doubts among the company's heads whether or not the factory would be able to restore its prewar turnover.

These doubts were soon overcome by the only really important kind of evidence, namely the restoration of old markets. Salesmanship and modern business methods were large contributory factors to this result. The immediate resumption of peace production had an excellent effect on commerce at a time when deliveries were doubtful and production of any sort, but especially in machine industries, was, to speak conservatively, uncertain.

The Austrian temperament, more engaging, conducive to compromise, more willing to please than that of the north German, drove a wedge into many markets still closed to Germany on the ground of prejudice. Just as Austrians have pleaded their case

so well in the councils of the League of Nations, so they tooted their goods in the markets of the world. Thus we see France and Italy high in the list of Böhler's customers, while Australia, most for bidding of all to German merchants, receives mention once more in the Böhler books. Nowhere was the export field more quickly regained than in Japan, a field which had been well developed 20 years before the war. England alone, the home of Sheffield steel, has proved a disappointment. There was a Böhler office in Sheffield before the war, but this was soon swallowed up in the enemy alien property confiscations. Failure to have its property restored, Böhler decided that the cost of bringing suit or starting in anew from the ground up would not justify the probable result. Instead the company has started after South American trade, recently opening a house in Buenos Aires.

Böhler's connections with Germany, as have been indicated, are exceedingly close. Up to January of this year, when the French made their move on the Ruhr, Germany was buying one-third of all the Böhler output. This consisted virtually of the total output of the Dusseldorf plant. It was this large German market which was originally responsible for the building of a plant in western Germany. Before 1914 the German market was supplied from Kapfenberg and the other Austrian plants. Competition was strong and the promptness of delivery was often a deciding factor. Expanding business and restricted space made the building of another plant imperative, and it was inevitable under the circumstances that this plant should be situated in the heart of the company's largest single foreign market. It is interesting to note, however, that not merely were the plans drawn up, but the actual building of the factory was commenced some months before the outbreak of the war. With the coming of hostilities it was immediately pushed to a hurried completion, requisitioned, like that at Kapfenberg, for munitions and other war materials, so that it was not actually used for its destined purpose until more than four years later. At the time of our visit to Vienna the occupation of the Ruhr was still in a state of deadlock. Herr Böhler was not of the opinion, however, that the German branch of the company would suffer seriously either from restrictive measures or from lack of fuel and raw materials.

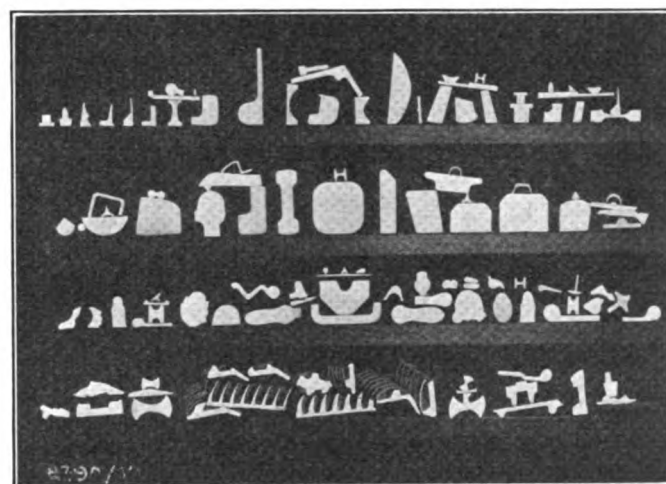
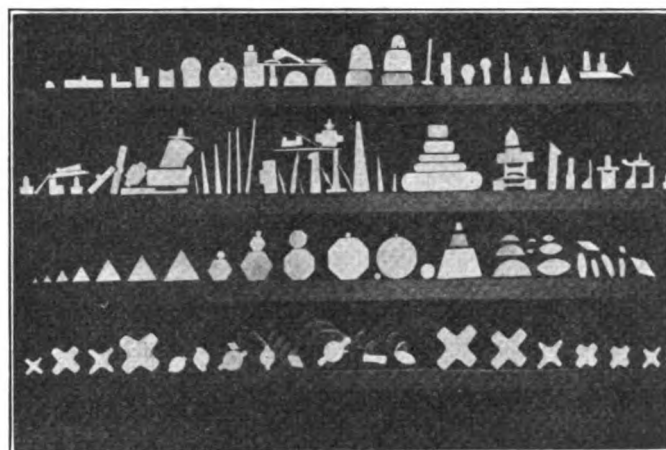
The prosperity over the Böhler company naturally makes its heads perhaps unduly optimistic over the future industrial recovery of Austria. On the other hand Herr Böhler probably knows the actual condition of the country as it exists today about as well as any other man in Austria.

"There is no doubt," he said, "that Austria at the moment is in the throes of an industrial and financial depression, due in large measure to the government's attempt to stabilize the crown, but owing chiefly, of course, to the fact that Austria has lost the greatest part of both her domestic markets and her large productive centers as well as her natural resources of coal. In discussing the future, however, we are compelled to disregard the latter factor, because there does not appear to be much hope of immediate restoration. We must consider industrial Austria in the light of what she is today.

"Stabilization of the currency, whether by artificial or other means, was vitally necessary for the restoration of the country, but was by no means an unmixed blessing either to producers or consumers. We see

this most clearly in Czecho-Slovakia where stabilization has been going on for a much longer period. Unemployment is rife, markets are difficult to obtain, and the cost of living at home has risen to some extent in spite of the high value of the currency.

"Much the same thing has happened here in Austria. In the domestic market especially we find that people are buying as little as possible because they are convinced that prices are about to fall. I doubt, however, that the stringency will last with us as long as with Czecho-Slovakia, because in our case the re-



Special sections of rolled steel. Steel in these sections is rolled in a separate plant exclusively equipped for the manufacture of such specialties. This selection representing only a small part of the range of profiles shows the manifoldness in the production.

sults have been confined chiefly within the country. They have not affected our foreign markets. The Böhler Company has a special problem to deal with in this connection because of its German factory. Owing to opposite tendencies in the two countries we see the value of the mark and of the crown rapidly approaching each other. This renders all our calculations uncertain from day to day.

"In the main, however, stabilization has had a healthy effect on the industrial life of the country. Indeed, at the present moment I doubt very much if the removal of government regulation would affect the value of the crown adversely except as fluctuations occurred through speculation. In actuality the crown

is not being supported by artificial means. There was even an occasion last winter when the government was compelled to keep the value of the crown from rising in order to avoid unnecessary embarrassment to industry. The present tendency of the crown is not to fall but to rise.

"However, the rise has not yet reached the point where we can safely finance our operations on a paper crown basis. Both our sales and purchases have been made on a gold basis ever since the end of the war, but it has sometimes been extremely difficult to educate our customers to the idea. There is a law against selling in terms of foreign currency within the country, but it is not generally regarded, and even the government collects its duties at the frontier in gold instead of paper crowns.

"The problem is not as simple as it sounds. It is easy to make up one's mind to sell and buy only in gold crowns, but, with the value of the paper crown where it is, it is not easy to put into effect. We and our customers all had to strip our minds entirely of the old ideas of money. We had to convince ourselves that the old currency no longer existed. A crown in June was not the same as a crown in July. One could not borrow money one month and promise to repay it the next. Finance required an entirely new frame of mind. Except for those few who were already dealing in gold crowns—principally those from whom we bought—we were compelled to accustom all those with whom we dealt to the new conditions. It was a long and not always successful process. Even today we find small buyers occasionally refusing to meet our terms. They think they can still pay in paper crowns. We have to show them why they can't.

"The future? Well, I think we are looking rather hopefully toward Russia. One reads a good deal about the possibility of an industrial alliance between Germany and Russia. Personally I think Austria's opportunity is much better than that of Germany. Vienna, you know, has always been the door leading directly into Russia. It is the gateway to the East. Our firm has always been on the best of terms with the Russians. It was with us that their engineers learned the art of making crucible steel. Of course just at present anything in the way of real business there would be too risky. But we have sent our salesmen there, though mostly for the purpose of looking over the field and reporting. We have also made certain tentative agreements with the Soviet government. I am convinced that Russia will develop to the necessary point within a very short time. Already there is a tremendous improvement which has come about only during the past year. When reconstruction actually begins it will go forward rapidly.

"When Russia returns to health—or, more correctly, when health returns to Russia—then the rest of industrial Europe will be able to resume its predestined course by means of its natural resources of raw materials, its water power, its agriculture, and the thrift and labor of its people in spite of war's devastation and in spite of new political alignments. We have learned that great nations can be utterly ruined yet their people continue to live. The only essentials are the ability to work and the will to do it. Both these conditions have been fulfilled in Austria, and for this reason I look for the return of national and personal prosperity."

Welding Locomotive Guide Rods

An interesting exhibit was brought to the attention of railroad men at the National Railway Appliance Association exhibition at the Coliseum, Chicago, recently. A new process for repairing locomotive guides was displayed by means of which the General Electric Company claims to have eliminated all difficulties previously encountered in renewing these guides and keeping them up to I. C. C. standards.

The process used was electric arc welding automatically applied. The guides were placed in an ordinary lathe and on the tool post, was mounted the automatic welder. When in operation, the guide remained stationary and the automatic welder traveled along with the carriage of the lathe, depositing electrode metal on the worn surface of the guide. The welding was applied on the side surface of the guide covering a width of two inches, beginning the welding on the inside and laying down adjacent beads working to the outer edge. Two layers of beads were required to build up the worn spot, a total of $\frac{3}{8}$ in. on each side. This was then machined away $\frac{1}{8}$ in. on each side, leaving a $\frac{1}{4}$ in. finished built-up stock. The length of the built-up guide was five feet. A total of three hours was required for welding both sides, using 150 amperes, 20 volts across the arc and $\frac{1}{8}$ in. diameter electrode wire.

Four Guides Reclaimed by Oxyacetylene Process.

Labor (8 hours at 75 cents).....	\$6.24
Oxygen (3.168 cu. ft. at \$1.75).....	5.54
Acetylene (4.024 cu. ft. at \$1.15).....	4.53
Wire (28 lbs. Manganese bronze—43 cents per lb.)	12.04

Total (four guides)..... \$28.35

Cost (one guide)..... 7.09

Four Guides Reclaimed by Automatic Electric Arc Process.

Labor (12 hrs. at 78 cents).....	\$9.36
Electric Power	2.40
Electrode (28 lbs. Roebling).....	2.53
Total (four guides).....	\$14.28

Cost (one guide)..... 3.57

—General Electric Bulletin.

A New Wire Fence Galvanizing Process

The development of a new process of galvanizing that trebles the life of woven wire fence has been announced by the Page Steel & Wire Company of Bridgeport, Conn. The new method is called "Galvanizing after Weaving."

The process applies a protecting coat of zinc to the fabricated wire that is five times heavier than that on ordinary galvanized wire.

Formerly the wire of which fence was made was first galvanized and then woven into fence, and due to the fact that considerable mechanical operations were performed, the thickness of the zinc coating was definitely limited. In the "galvanizing after weaving" method, the mechanical operations are all performed first, and the fabric is then galvanized, thus permitting the application of a "super-heavy" coating of zinc.

In service tests, wire bearing the thickness of coating that is applied by the new method has successfully withstood exposure in New England for more than seven years. It is pointed out that inasmuch as the "galvanized after weaving" method trebles the life of fence, it reduces service costs about two-thirds for the user.



W. U. FOLLANSBEE

WALTER C. CARROLL

W. S. HORNER

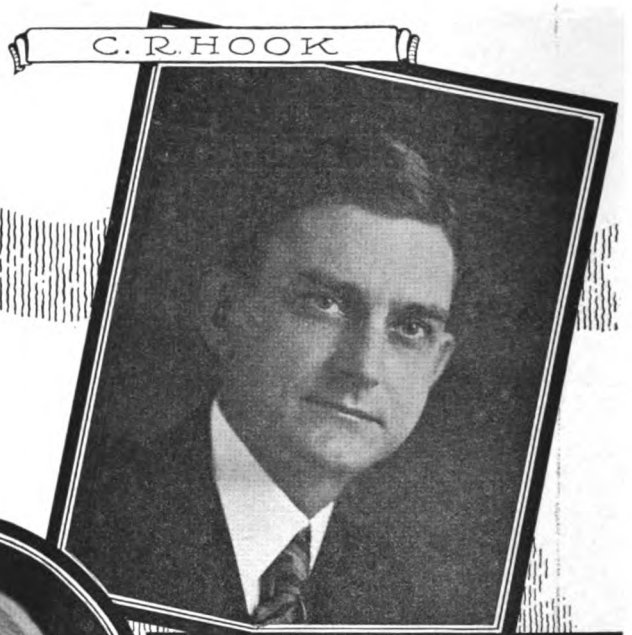
W. W. LOWER

G. H. CHARLS

A.M. OPPENHEIMER

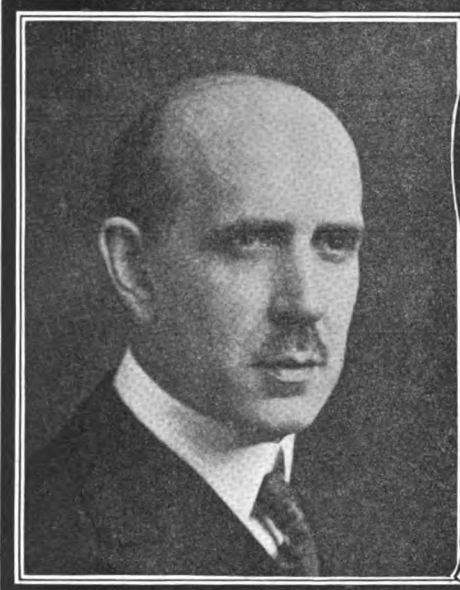


C. R. HOOK



GEO. M. VERITY

L. D. MERCER G. F. AHLBRANDT



JAMES M. LARKIN



F. W. BEACH



SHEET AND TIN PLATE

Sheet Steel Executives Convene

White Sulphur Springs Meeting Results in Trade Extension Plan
Ratification by 80 Per Cent of Independents

THE second annual meeting of sheet steel executives brought to a successful conclusion the seven years' campaign for organized trade extension effort. At the conclusion of the final session, President W. S. Horner, of the National Association of Sheet and Tin Plate Manufacturers, was tendered a rising vote of thanks in recognition of his most successful effort.

The purpose of the meeting, held at Hotel Greenbrier, May 12, 13, 14, 15, was for the "careful study, joint consideration and discussion of vital problems affecting the sheet steel industry, also to widen and deepen friendship within its circle." Judged by the atmosphere of unanimous satisfaction and approval, and the evident reluctance to separate, the purposes suggested were conclusively accomplished.

Executive sessions were conveniently divided into three separate sub-divisions, administration, distribution, and production.

Administration—Under the chairmanship of Severn P. Ker, President Sharon Steel Hoop Co., Sharon, Pa.

Mr. Horner's address, "The Sheet Steel Industry," sounded the keynote for the entire convention. Reviewing the early growth of the industry, he submitted many tabulated comparisons which emphasized his points. Among these, a list of the major users of sheet steel shown by percentage of tonnage is as follows:

Class	Per Cent
Automotive industry	37.7
Jobbers	13.0
Electrical manufacturers	7.8
Roofing	5.2
Barrel and keg manufacturers.....	4.3
Export	4.0
Stove and range.....	3.5
Refrigerators and range boilers.....	3.2
Metal furniture	2.8
Building construction	2.2
Water troughs and grain bins.....	1.9
Culvert and flume.....	1.9
Car builders	1.8
Farm implements	1.1
Tack and nail plate.....	.2
Casket and vault manufacturers.....	.2
Miscellaneous	9.2
	100.0

Mr. Horner's address will be published in full in the July issue of this magazine.

"The Relation of Administration to Operation," by Clayton L. Patterson, Secretary of Labor Bureau, National Association of Sheet and Tin Plate Manufacturers. Mr. Patterson struck a happy vein when he stressed the qualifications most needed by executives in the conduct of modern complex industrialism. With-

out the ability to select with judgment and foresight those men upon whose shoulders the burden of actual operation must rest, any executive must fail, irrespective of his capacity for work or his general intelligence.

Mr. George M. Verity, President of the American Rolling Mill Company, Middletown, Ohio, was most timely in his address, "Industrial Stability."

Momentary fluctuations, successes or failures should be considered in a purely relative way, an average perspective can only be gained by comprehending a period of years as a unit. Five years was suggested as a logical period, but not an arbitrary period, in which to weigh comparisons. Coming at this moment of reaction in industry, Mr. Verity's plea for stability took on added significance. Rather is not stability a question of the human instabilities and lack of vision, rather than any inherent weakness in the industrial fabric itself.

"Economic Factors and Administration of Industry," by Leslie M. Vickers of the National Industrial Conference Board, brought out very clearly through the aid of charts and curves the evident relations between costs of living and wages. Standards not costs is the insistent cry of today's breadwinners.

Distribution.

Mr. Walter C. Carroll, vice president, Inland Steel Company, Chicago, Ill., presided as chairman of the Distribution sessions.

"Economy and Elimination of Waste in the Sheet Steel Industry," by A. E. Foote, of the U. S. Department of Commerce, Washington. Major Foote gave an interesting survey of this most important phase of work now being carried on under Secretary Hoover's direction. Innumerable instances were cited showing progress made by other industries, and the way was pointed out where by the sheet steel industry may profit by the experiences and methods already gained and applied. Reference to the availability of the Bureau of Standards' vast laboratory resources indicated points of common contact.

"Feasibility and Advantage of Trade Promotion Through United Effort," was the subject of Mr. Murray Springer, Executive Vice President, Crosby Company, Chicago, which company recently completed the general plan for sheet steel trade extension. The plan provides for a publicity campaign which is expected to involve the expenditure of approximately \$900,000, divided over a period of three years. The funds are to be secured through an assessment upon a tonnage basis to be levied upon all signatory companies' product. Assuming an annual tonnage of

about 3,000,000 tons of sheets per year, and assessment of about 10c per ton will provide the necessary revenues.

"Is the Trade Extension Plan Legal?" Mr. T. D. McCloskey, General Counsel, National Association of Sheet and Tin Plate Manufacturers, laid emphasis upon the underlying motive of the association, namely, to increase the sales and uses of sheet steel, and for that reason should meet no legal interferences.

Mr. L. D. Mercer, Sales Manager of the United Alloy Steel Corporation, of Canton, O., presented a most telling analysis of the factors upon which the steel business has rested, and indicated some of the difficulties which confronted the very acceptance of the idea of publicity. The Steel Industry as a whole deals and thinks in terms of tonnage. The Sheet Steel Industry has contented itself with producing sheets and left it up to the distributor to sell them. Progress in selling, merchandizing or advertising, as the terms are modernly understood, has been conspicuous by its absence.

Mr. W. V. Follansbee, President of Follansbee Brothers Company, Pittsburgh, Pa., drew an analogy between results obtained by the jobbing division of Follansbee Brothers Company, in the sales of sheet copper, as a result of the publicity campaign carried on by the Copper and Brass Research Association. The Zinc Institute effort in the same direction is bearing fruit. Speaking specifically, Mr. Follansbee called attention to a single class of receptacles, which, if made exclusively of sheet steel, would require 50,000 tons to supply a city of 2,000,000 people.

Mr. Roy de Staebler, Manager of Sales, Beck & Corbitt Iron Company, St. Louis, voiced the opinion of the large jobber. He bore a message from the Zinc Institute, which in substance was a prayer for "Two Ounce Coating." Over a million tons of sheet steel roofing was now being lost annually to prepared roofings due conspicuously to the fact that low standards of galvanizing had been allowed to creep into the sheet business. "Give us jobbers 'two ounce sheet' and we will sell it, otherwise the galvanized business may as well be relegated to the archives."

Production.

Mr. Charles R. Hook, vice president, American Rolling Mill Company, Middletown, Ohio, presided as chairman of this division.

"Labor Supply," an address by Cyrus S. Ching, supervisor of industrial relations, M. S. Rubber Company, New York, summarized the changing conditions of vital employment in the light of intimate statistics available to the National Manufacturers' Association. "Man power must be conserved."

"Better Understanding Between Management and Men," by James M. Larkin, assistant to the president, Bethlehem Steel Company, Bethlehem, Pa., was a concrete story of Bethlehem's solution of this modern problem.

"The Development of Labor Saving Machinery in the Steel Industry."

In this important discussion, Mr. L. D. Mercer, Sales Manager of the United Alloy Steel Corporation of Canton, Ohio, was called upon to deliver the address of Mr. G. H. Charls, Vice President and General Manager of the same company.

The growth of working power during the last 50 years of progress has been from 68,000 h.p. per 1,000,-

000 inhabitants in 1880, to 228,000 h.p. per 1,000,000 inhabitants in 1914.

To secure accurate data covering the substitution of mechanical means where formerly hand labor was involved, a questionnaire to various mills was submitted. The replies cover a wide range of activities. A list from a single concern is suggestive:

Cement guns for sealing up furnaces and checkers.
Slag guns for cleaning slag from open hearth cinder pockets.

Mechanical methods for spraying mold interiors.

Gravity conveyors for hauling brick, spelter, lumber, etc.

Tractors and trucks for internal transportation.

In addition, many other applications already accomplished, such as, mechanical brick handling for furnace rebuilding; coal-handling by drag-line bucket method; introduction of roller-bearings on ingot-buggies; water cooled furnace ports; automatic handling of sheets in pickling, which reduces man-power and improves quality of product; pack-opening machines, which reduce the hazard incident to this clumsy hand operation, and many others too numerous to mention, each frequently leading to a further development long considered impossible.

"Public Policy and Production." Mr. James A. Emery, General Counsel of the National Manufacturers Association of Washington, D. C., presented this inclusive subject as only Mr. Emery himself is qualified to do. Building upon an historical background, the speaker led his receptive audience through the successive stages of human progress, the while calling upon the broad perspective of his years of experiences not with a single industry but with the many to clinch the points so frequently made. The enthusiasm shown at his conclusion formed a fitting climax to a gathering which will go down in sheet steel history as the meeting where the accomplishments were worthy of the quality of the attendance.

The roll of attendance follows:

ROLL OF ATTENDANCE

ALAN WOOD IRON & STEEL COMPANY
PHILADELPHIA, PA.

MR. RICHARD G. WOOD, *President*
MR. W. W. LUKENS, *Vice President*
MR. C. O. HADLY, *Gen. Mgr. Sales*

ALLEGHENY STEEL COMPANY
BRACKENRIDGE, PA.

MR. H. E. SHELDON, *President*
MR. ROBT. D. CAMPBELL, *Vice President and Treasurer*
MR. JAMES O. CARR, *Vice President*
MR. PAUL F. VOIGHT, JR., *General Sales Agent*

THE AMERICAN ROLLING MILL COMPANY
MIDDLETOWN, OHIO.

MR. GEORGE M. VERITY, *President*
MR. C. R. HOOK, *Vice Pres. and Gen. Mgr.*
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27th Annual Convention A. S. T. M.

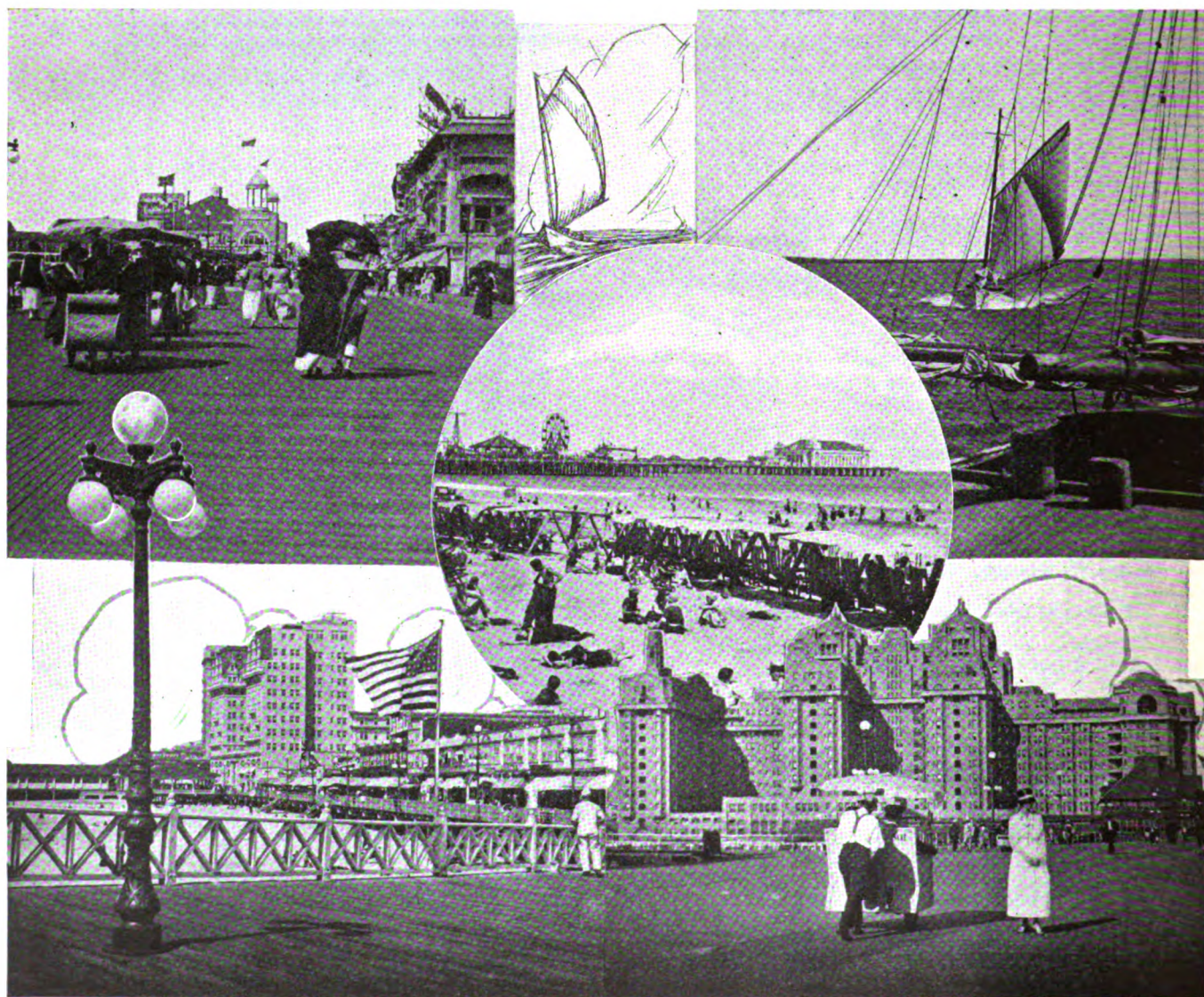
Metal and Non-Metal Sessions to Be Held Simultaneously

THE twenty-seventh annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall, Atlantic City, N. J., during the week of June 23. A notable departure is being made this year by the Committee on Papers in the arrangement of the program by which parallel sessions will be held practically throughout the meeting, beginning Tuesday afternoon, June 24, and closing on Friday evening, June 27.

The ever increasing volume of business coming before the Society has, under the plan of "single" sessions, made the meetings longer than was thought desirable, the meeting last year having been started for the first time on Monday night. The activities of the Society divide naturally into metals and non-metals. The arrangement of the program heretofore has brought these two groups to the annual meeting for the most part at opposite ends of the program, having the tendency to "split" the membership of the Society rather sharply. Moreover, with sessions of

the Society morning, afternoon and evening of practically every day, it was no longer possible to avoid the holding of committee meetings without seriously interfering with these sessions.

Accordingly, the program this year has been arranged so that two sessions are held simultaneously at all but two periods at which the Society meets. The program on metals extends throughout the meeting and the sessions on non-metals have been scheduled against the metals sessions with little conflict of subject matter and group interest. In this way the meeting has been shortened as much as possible, consistent with opportunity for proper consideration of the reports and papers. The several groups of interests in the Society are brought more closely together, thus providing opportunity for extending acquaintance and good fellowship among members. With the exception of Tuesday, there will be no afternoon sessions of the Society, these periods being reserved for recreation and committee meetings.



Some Features of the Annual Meeting.

An outstanding feature of the program is the prominence of reports and papers on metals. Sufficient material in this field has been accepted by the Committee on Papers to extend its consideration over the entire meeting.

Corrosion.—The subject of corrosion is one of the big attractions at the meeting. The Symposium on Corrosion-Resistant, Heat-Resistant and Electrical-Resistance Alloys is creating widespread interest and unquestionably will result in the bringing together of a fund of valuable information regarding these alloys and their properties. One of the features of the symposium is a tabulation of the composition and properties of practically all of the alloys of this type manufactured in this country. Second only in significance are the reports of the Society's two committees A-5 and B-3 on corrosion. Papers on methods of corrosion testing complete this part of the program.

Endurance of Metals.—The importance of this subject warrants the continued discussion of it in the Society. Three papers are to be presented which will bring before the members detailed reports of endurance tests of ferrous and non-ferrous metals made by the U. S. Bureau of Mines, the U. S. Naval Engineering Experiment Station and the U. S. Air Service.

Cast Iron Pipe.—On the program are included two important contributions on the subject of cast-iron pipe, one that has engaged the attention of water-works and other engineers and the producers for a number of years. These papers will present data on extensive series of tests that have not heretofore been published and a very interesting discussion is being planned.

Effect of Sulphur on Steel.—The joint committee on this subject is planning to present the results of two supplementary investigations of rivet steel first reported on two years ago, i. e., endurance tests and an extensive metallographic examination. A preliminary report on the effect of sulphur on the second group of residual sulphur steels corresponding to medium-carbon structural material will also be presented.

In addition, the various metals committees have been particularly active and are presenting reports whose importance can only generally be indicated on the program. Attention should also be called to the several interesting papers on the properties of metals not mentioned above.

Methods of Testing and Nomenclature.

These two subjects are of very general interest and the Reports of Committees E-1 and E-8 should interest every member. Committee E-1 is making important recommendations respecting tension, compression and Brinell hardness tests of metals, and the standardization of testing sieves. This session also includes several general papers on testing.

The usual entertainment features will be provided. There will be an informal dance and smoker on Wednesday evening. Friday afternoon will be devoted to recreation and at this time the annual golf and tennis tournaments will be held. Additional entertainment will be provided and the committee is planning to make these features attractive to members and the ladies accompanying them.

TENTATIVE PROGRAM

Tuesday, June 24

2:00 P.M.—First Session. (Held simultaneously with Second Session.) Symposium on Corrosion-Resistant, Heat-Resistant and Electrical-Resistance Alloys.

Introduction to Symposium, with Tabulation of Manufacturers' Data on Composition and Properties of the Alloys. Jerome Strauss, Chairman.

Corrosion-Resistant Metals—Past, Present and Future. P. A. E. Armstrong.

Corrosion-Resistant Alloys for Use in Mine Water. R. J. Anderson and G. M. Enos.

Endurance Properties of Corrosion-Resistant Steels. D. J. McAdam, Jr.

Non-Rusting Chromium-Nickel Steels. B. Strauss.

Stainless Steels: Their Heat Treatment and Resistance to Sea-Water Corrosion. Jerome Strauss and J. W. Talley.

The Carrying Capacity of Ball Bearings Made of Stainless Steel. Axel Hultgren.

(Symposium continued in Third Session.)

3:00 P.M.—Second Session. (Held simultaneously with First Session.) On Coal, Timber, Rubber and Textiles.

Report of Committee D-5: On Coal and Coke. A. C. Fieldner, Chairman.

The Strength of Structural Timbers: Influence of Defects and a Discussion of Variability. J. A. Newlin and R. P. A. Johnson.

Report of Committee D-7: On Timber. Hermann von Schrenk, Chairman.

Report of Committee D-10: On Shipping Containers. J. A. Newlin, Chairman.

Report of Committee D-11: On Rubber Products. F. M. Farmer, Chairman.

Report of Committee D-13: On Textile Materials. A. E. Jury, Chairman.

8:00 P.M.—Third Session. (Held simultaneously with Fourth Session.) Symposium on Corrosion-Resistant, Heat-Resistant and Electrical-Resistance Alloys. (Continued from First Session.)

Metals for High-Temperature Service—Past, Present and Future. F. A. Fahrenwald.

Deterioration of Metals in Hot Reducing Gases. J. S. Vanick.

Some Engineering Applications of High-Chromium Iron Alloys. C. E. MacQuigg.

Steels for Automotive Engine Valves. J. B. Johnson and S. A. Christiansen.

Cast Metals for High-Temperature Service. L. O. Hart.

Some Electrical Properties of High-Resistance Alloys. M. A. Hunter and A. Jones.

Characteristics of Some Materials for Base-Metal Thermocouples. F. E. Bash.

8:00 P.M.—Fourth Session. (Held simultaneously with Third Session.) On Paints, Petroleum Products, Insulating Materials and Thermometers.

Report of Committee D-1: On Preservative Coatings for Structural Materials. Allen Rogers, Chairman.

Accelerated Weathering. H. A. Nelson and F. C. Schmutz.

Report of Committee D-15: On Thermometers. W. H. Fulweiler, Chairman.

Report of Committee D-2: On Petroleum Products and Lubricants. C. P. Van Gundy, Chairman.

A Method for Determining the Oxidation Value of Lubricating Oils. T. S. Sligh, Jr.

Report of Committee D-9: On Electrical Insulating Materials. F. M. Farmer, Chairman.

Sludging Tests for Transformer Oils. E. A. Snyder.

Wednesday, June 25

9:30 A.M.—Fifth Session. (Held simultaneously with Sixth Session.) On Non-Ferrous Metals, Corrosion and Metallography.

Report of Committee B-1: On Copper Wire. J. A. Capp, Chairman.

Report of Committee B-2: On Non-Ferrous Metals and Alloys. William Campbell, Chairman.

Report of Committee A-5: On Corrosion of Iron and Steel. J. H. Gibboney, Chairman.

Types of Apparatus Used in Testing the Corrodability of Metals. H. S. Rawdon, A. I. Krynsky and W. H. Finkeldey.

Report of Committee B-3: On Corrosion of Non-Ferrous Metals and Alloys. E. C. Lathrop, Chairman.

An Accelerated Electrolytic Corrosion Test. R. J. Anderson and G. M. Enos.

Report of Committee D-14: On Screen Wire Cloth. R. W. Woodward, Chairman.

Report of Committee E-4: On Metallography. W. H. Bassett, Chairman.

9:30 A.M.—Sixth Session. (Held simultaneously with Fifth Session.) On Lime, Gypsum and Ceramics.

Report of Committee C-3: On Brick. T. R. Lawson, Chairman.

Report of Committee C-4: On Clay and Cement Sewer Pipe. A. J. Provost, Jr., Chairman.

Report of Committee C-5: On Fireproofing. I. H. Woolson, Chairman.

Report of Committee C-7: On Lime. H. C. Berry, Chairman.

Report of Committee C-11: On Gypsum. W. E. Emley, Chairman.

Properties of Gypsum Tile. J. Miller Porter.

Report of Committee C-10: On Hollow Building Tile. S. H. Ingberg, Chairman.

Wednesday Afternoon—Recreation. Committee meetings.

8:00 P.M.—Seventh Session. Presidential Address and Reports of Administrative Committees.

Annual Address by the President. Guillaem Aertsen.

Annual Report of the Executive Committee. C. L. Warwick, Secretary-Treasurer.

Report of Committee E-6: On Papers and Publications. C. L. Warwick, Chairman.

This Session will be followed by an Informal Dance and Smoker.

Thursday, June 26

9:30 A.M.—Eighth Session. (Held simultaneously with Ninth Session.) On Steel.

Report of Committee A-1: On Steel. F. M. Waring, Chairman.

Report of Committee A-4: On Heat Treatment of Iron and Steel. H. M. Boylston, Chairman.

Report of the Joint Committee on Investigation of Phosphorus and Sulphur in Steel. George K. Burgess, Chairman.

How Can the Benefits of A. S. T. M. Standardization Be Secured to the Small User? T. H. Wiggin.

High Tensile Strengths with Low-Carbon Steels. R. H. Smith.

Composition and Physical Properties of Cast 12-per-cent Manganese Steel. J. H. Hall and G. R. Hanks.

Report of Committee A-9: On Ferro Alloys. F. C. Langenberg, Chairman.

9:30 A.M.—Ninth Session. (Held simultaneously with Eighth Session.) On Road and Paving Materials and Waterproofing.

Accelerated Wear Tests of Concrete. F. H. Jackson, Jr.

Methods of Securing Samples of Completed Pavements with Reference to the Determination of the Quality of the Cement-Concrete Foundation. E. E. Butterfield.

Report of Committee D-4: On Road and Paving Materials. F. P. Smith, Chairman.

Tests for Stability of Bituminous Mixtures. B. A. Anderton and H. M. Milburn.

Blown Oils. H. B. Pullar.

Report of Committee D-8: On Waterproofing Materials. S. T. Wagner, Chairman.

Thursday Afternoon—Recreation. Committee meetings.

8:00 P.M.—Tenth Session. On Methods of Testing and Nomenclature.

Report of Committee E-8: On Nomenclature and Definitions. Cloyd M. Chapman, Chairman.

Report of Committee E-1: On Methods of Testing. J. A. Capp, Chairman.

A Study of Sieve Specifications. J. V. Judson.

Testing Sieves. D. A. Abrams.

Physical Tests of Thin-Gage Metals and Light Alloys. H. A. Anderson.

Determination of Poisson's Ratio and a Suggestion for Its Use in Stress Analysis. T. M. Jasper.

Direct Measurement of Poisson's Ratio for Concrete. A. N. Johnson.

Friday, June 27

9:30 A.M.—Eleventh Session. (Held simultaneously with Twelfth Session.) On Magnetic Analysis and Fatigue of Metals.

Report of Committee A-6: On Magnetic Properties. C. W. Burrows, Chairman.

Report of Committee A-8: On Magnetic Analysis. F. P. Fahy, Chairman.

Magnetic Tests of A. S. T. M. Drills. W. B. Kouwenhoven.

Notes on Some Endurance Tests of Metals. H. W. Gillett and E. L. Mack.

Accelerated Fatigue Tests and Some Endurance Properties of Metals. D. J. McAdam, Jr.

The Resistance of Metals to Repeated Static and Impact Stresses. R. R. Moore.

9:30 A.M.—Twelfth Session. (Held simultaneously with Eleventh Session.) On Cement and Concrete.

Report of Committee C-1: On Concrete. R. S. Greenman, Chairman.

Report of Committee C-6: On Drain Tile. Anson Marston, Chairman.

Laboratory Investigations of the Influence of Curing Conditions and Various Admixtures on the Life of Concrete Stored in Sulphate Solutions as Indicated by Physical Changes. D. G. Miller.

Influence of Aggregates upon Shrinkage of Mortar and Concrete. Cloyd M. Chapman.

Calcium Chloride as an Admixture in Concrete. D. A. Abrams.

Effect of End Condition of Test Cylinder on Compressive Strength of Concrete. H. F. Gonnerman.

Friday Afternoon—Recreation. Golf and tennis tournaments.

8:00 P.M.—Thirteenth Session. (Held simultaneously with Fourteenth Session.) (On Wrought and Cast Iron and Cast Pipe.

Report of Committee A-2: On Wrought Iron. H. E. Smith, Chairman.

Chain: The Effect of Proofing and of Annealing on Brittleness in Large Chain Links. C. G. Lutts.

Report of Committee A-7: On Malleable Castings. Enrique Touceda, Secretary.

Report of Committee A-3: On Cast Iron. Richard Moldenke, Chairman.

Recent Investigations on Cast Iron for Pipe. Richard Moldenke.

The American Water Works Association Test Bar. J. T. MacKenzie.

Discussion: On Cast Iron Pipe.

8:00 P.M.—Fourteenth Session. (Held simultaneously with Thirteenth Session.) On Concrete and Reinforced Concrete.

Report of Committee C-9: On Concrete and Concrete Aggregates. A. T. Goldbeck, Chairman.

A Southern Rolling Mill

Overcomes Unusual Locational Difficulties by Adhering to Quality-Service Standards

By M. P. LAWTON*

THE Atlantic Steel Company occupies the rather unique position of being the only steel manufacturing plant in the state. In size it is rather small as steel plants go. This, together with its isolation, present many problems which make it in some respects more interesting than the average.

Such a plant will naturally suffer from certain limitations as well as profit by other advantages. The limitations of size need not be dwelt upon. It is only necessary to mention the disadvantage of transporting

all raw materials by rail, and that of being more or less out of direct contact with other concerns of a similar nature.

On the other hand, this plant is located in a strategic position for distribution of its products. Atlanta, Georgia, is a sort of hub from which radiate eight different railroads, many of them operating several lines; a number of suburban electric lines; and truck roads leading to every section of the southeast. It is not surprising therefore, that its sales territory extends from the Mexican border on one hand to the very

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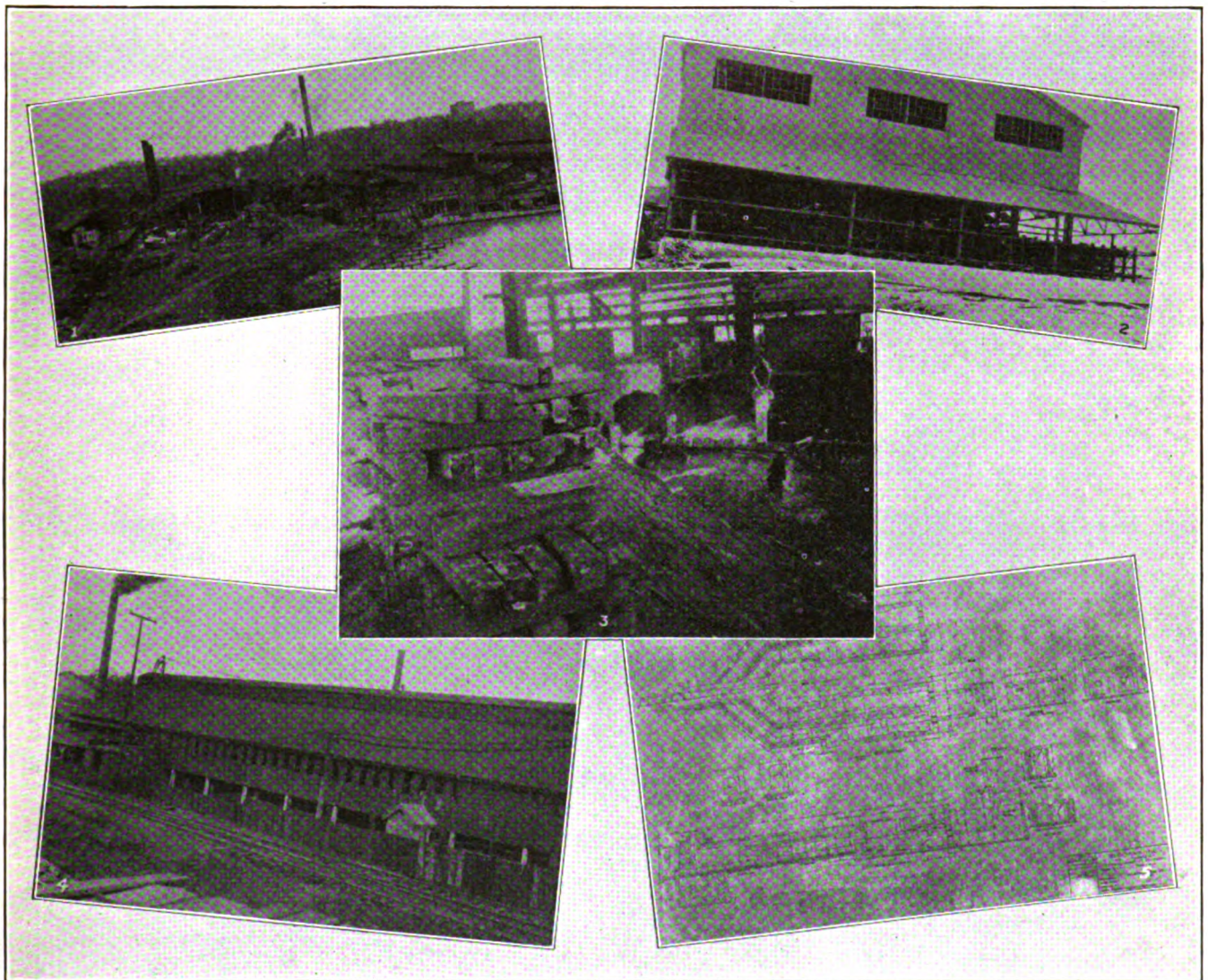


FIG. 1—General view of the Atlantic Steel Company. FIG. 2—Storage racks for flat stock. The 204 racks shown provide for storage of over a million pounds of flats and small angles. The total floor space is 26 ft. x 70 ft. FIG. 3—Open hearth pit. Ingots are placed on the skids by a 10-ton crane. Then they are shoved by a hydraulic pusher on to a set of live rollers, by which they are conveyed to a point which can be reached by the soaking pit crane. One section of the roll table together with an independent driving motor is on a scale platform by which the ingots are weighed one at a time. FIG. 4—The original Atlanta Steel Hoop Company. This picture shows the original mill, built in 1901 for rolling hoop and cotton ties. The steel warehouse in the background is of later construction. FIG. 5—Diagram of soaking pit. Pulverized coal is blown in by fan air, through the long burner pipe shown. Each pit holds 10 to 14 ingots.

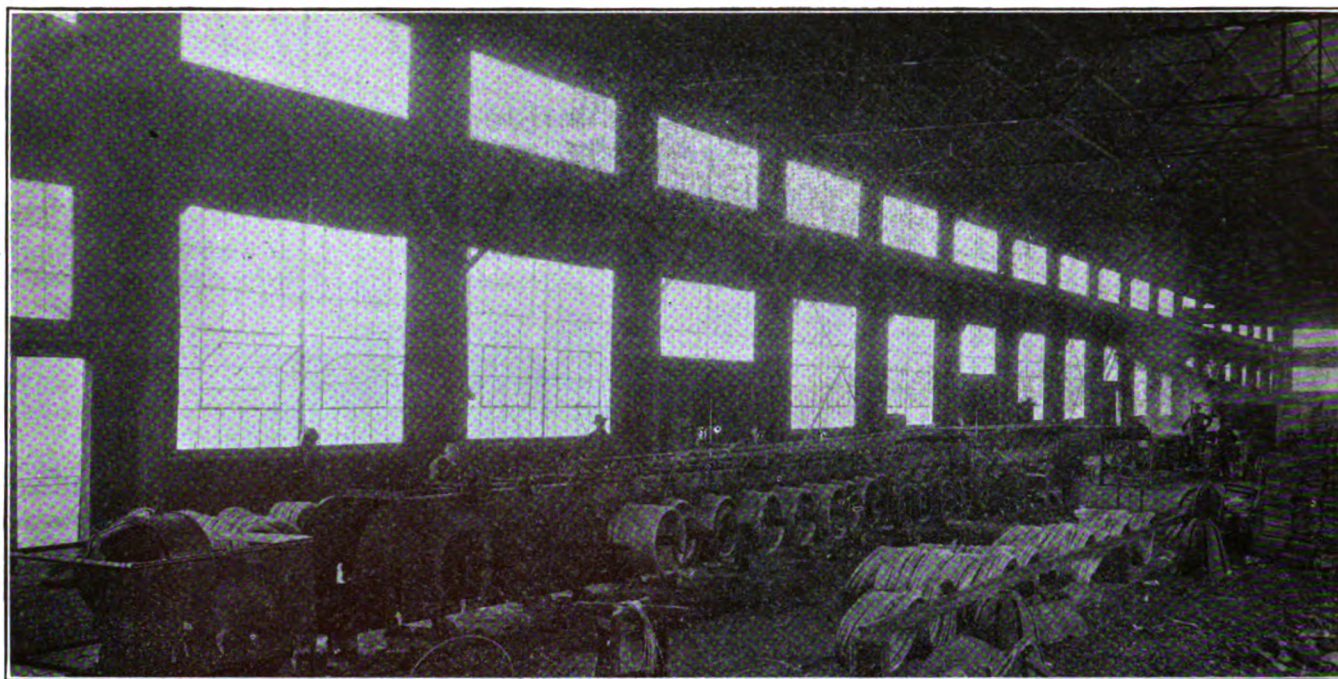


FIG. 6—Galvanizer. Showing worm-driven and gear-driven frames. Spelter pan and hooded acid tub in background.

doors of the Pittsburgh district on the other, besides a very considerable export trade.

Other advantages lie in the excellent climate and living conditions of Atlanta, and in the fact that there is quite a good local market for semi-finished products.

Lastly, there is an advantage common to smaller plants — the possibility of paying closer attention to details. This, along with the central location mentioned above, have resulted in the two aims of the company which have grown to the proportions of slogans, namely, (1) quality, and (2) service.

This company was started in 1901 as the Atlanta Steel Hoop Company, manufacturing hoop and cotton

ties. Billets were bought in other cities for four years, when the plant was enlarged by the construction of two open hearth furnaces, blooming, rod, spike, wire, nail and fence mills.

The original furnaces were of 35 ton capacity, but have since been rebuilt for 60 tons. Producer gas is used for fuel. In 1916 a third furnace was added and is arranged to burn either fuel oil or powdered coal. With this furnace it is possible to produce a 60 ton heat in less than eight hours.

Ingots are poured from a 60 ton ladle, stripped almost immediately and charged directly into adjoining soaking pits, as shown. Originally they were re-



FIG. 7—Cotton tie warehouse. Cotton ties are dipped 100 bundles at a time and placed on the racks to drain. When dry they are stacked in the warehouse or loaded into box cars by means of the chute at the left.

heated in continuous gas-fired furnaces, but these have been superseded by eight soaking pits, holding 10 to 14 ingots each and fired with pulverized coal.

The 25-inch blooming mill was originally driven by a 1350 h.p. twin reversing engine, which has recently been replaced by a 5000 h.p. reversing motor. The six stand billet mill is driven by a 1600 h.p. induction motor. Billets range from $1\frac{1}{2}$ inch to $2\frac{1}{4}$ inch, according to the use for which they are intended.

The original 8-in. Hoop Mill has been supplemented with a 10-in. mill, the two together having a capacity of 400 tons per day. The range of sizes rolled

lars in rolling one dollar's worth of product. This disadvantage has been largely overcome by the installation of complete storage facilities for cotton ties, bands, flats and angles as shown in the photos. It is a very tangible outgrowth of the "service" end of this company's slogan that any desired quantity of most standard products can now be shipped from stock without delay.

The Rod Mill is a 14-stand, 10-inch Garrett type, with continuous roughing rolls. This mill, the last remaining steam driven unit in the plant, was electrified in 1922. Its original capacity was 60 tons; but

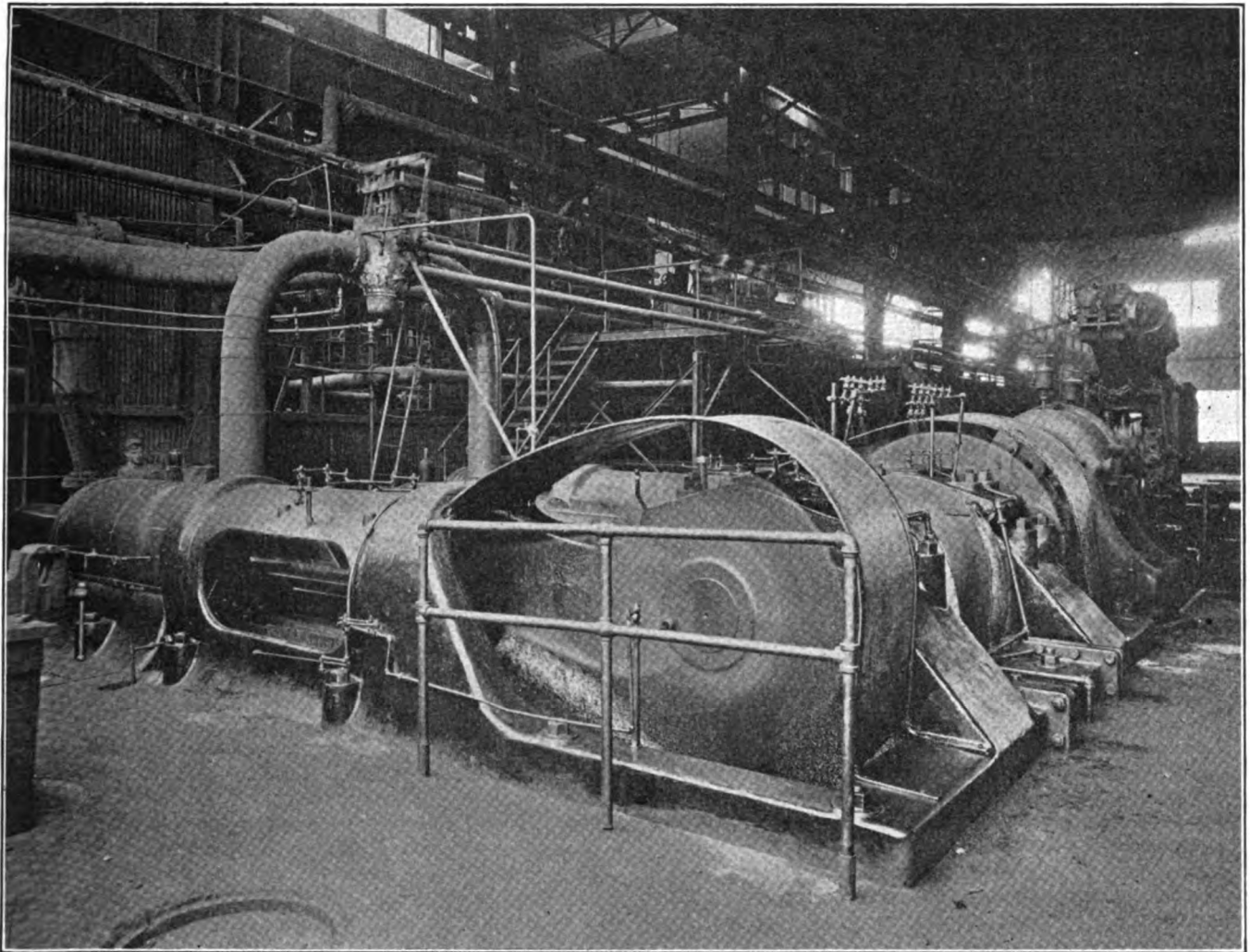


FIG. 8—Former blooming mill engine. This 28-in. x 33-in. twin reversing steam engine of 1350 h.p. has been replaced by the electric motor shown.

is rather wide, covering the thinnest trunk strips to heavy flats. A partial list of the products made on these mills is as follows:

1. Cotton ties.
2. Hoop.
3. Bands.
4. Flats, up to $\frac{5}{8}$ -in. x 3-in.
5. Saw Blades ($\frac{1}{8}$ -in. x 3-in., high car).
6. Angles, in bar sizes.
7. Special shapes, to order.

This very diversity of products constitutes one of the previously-named disadvantages of a small mill, and often it has been necessary to spend three dol-

lar by bit this capacity has been increased until it can now produce 150 tons in 12 hours.

The mill is equipped with both reels and cooling bed. Small rounds are usually run to the reels and straightened and sheared afterwards, thus insuring uniformity of quality and length. A large proportion of the output from this mill is concrete reinforcement bar, both corrugated and square twisted. It supplies all the southern tonnage for the Kalman Steel Company.

A vigorous campaign for quality has been conducted in this mill, particularly in the matter of plain bar. By constant study and rigid inspection the quality of this product has been improved greatly in the

past few months. Bar is inspected on the cooling bed by means of solid snap gages made to the A. S. T. M. rolling tolerances, a different gage being necessary for each size. In addition, two complete sets of gages are used, one for hot bar and another for cold, since the shrinkage in cooling from a red heat amounts to six thousandths of an inch on a bar one inch in diameter.

As in the Hoop Mills, it is necessary to carry a large stock of corrugated and plain bar. It is planned to construct a set of storage racks for this purpose in order to economize on space and promote orderliness.

The Warehouse is equipped with a double-ended power bending bench and hand bending facilities for making stirrups, column hoops, beam and slab bars; and specially fabricated units for concrete reinforcement.

The Wire Mill consists of 50 blocks and four Morgan continuous wire-drawing machines. In addition, there are on hand new benches totalling 24 blocks ready for installation.

The galvanizer has been rebuilt within the past two years. It consists of one worm-driven frame of 30 reels and one gear-driven frame of 12 reels. Part of the reels on the latter turn faster and the rest slower than those on the main frame, so that very large or very small wire can be run at the most advantageous speed.

The Nail Mill consists of 50 nail machines, two staple machines, barbing machine and rumblers. All

standard sizes and specifications are run on this mill, and a heavy tonnage of stock is carried on hand at all times.

All sizes and styles of barbed wire are made to order. Standard styles are kept in stock at all times for shipments on short notice.

Two general types of field fencing are woven—the "knot" fence and the "wrapped joint" fence. Each of these is made in a variety of sizes, ranging from 26 inches to 72 inches in height, every style being kept in stock in considerable tonnage. There are now in operation four "knot" type looms, and three "wrapped joint" looms. Three additional machines of the latter type are now under construction, and will be put into service shortly.

It will be noticed from the foregoing summary that a plant the size of this is continually beset with the problem of stock. It is always a question of just how much material to keep on hand, whether to tie up money in large stocks, or to risk having to change over a machine or a mill in order to fill an order for a small quantity. With "Service" as their basis of operation, however, the decision has been in favor of the former policy.

A standard type of warehouse has been adopted, of steel construction, 70 feet wide, and served by five-ton overhead traveling cranes. To date there have been four such warehouses built.

(Concluded on page 305)

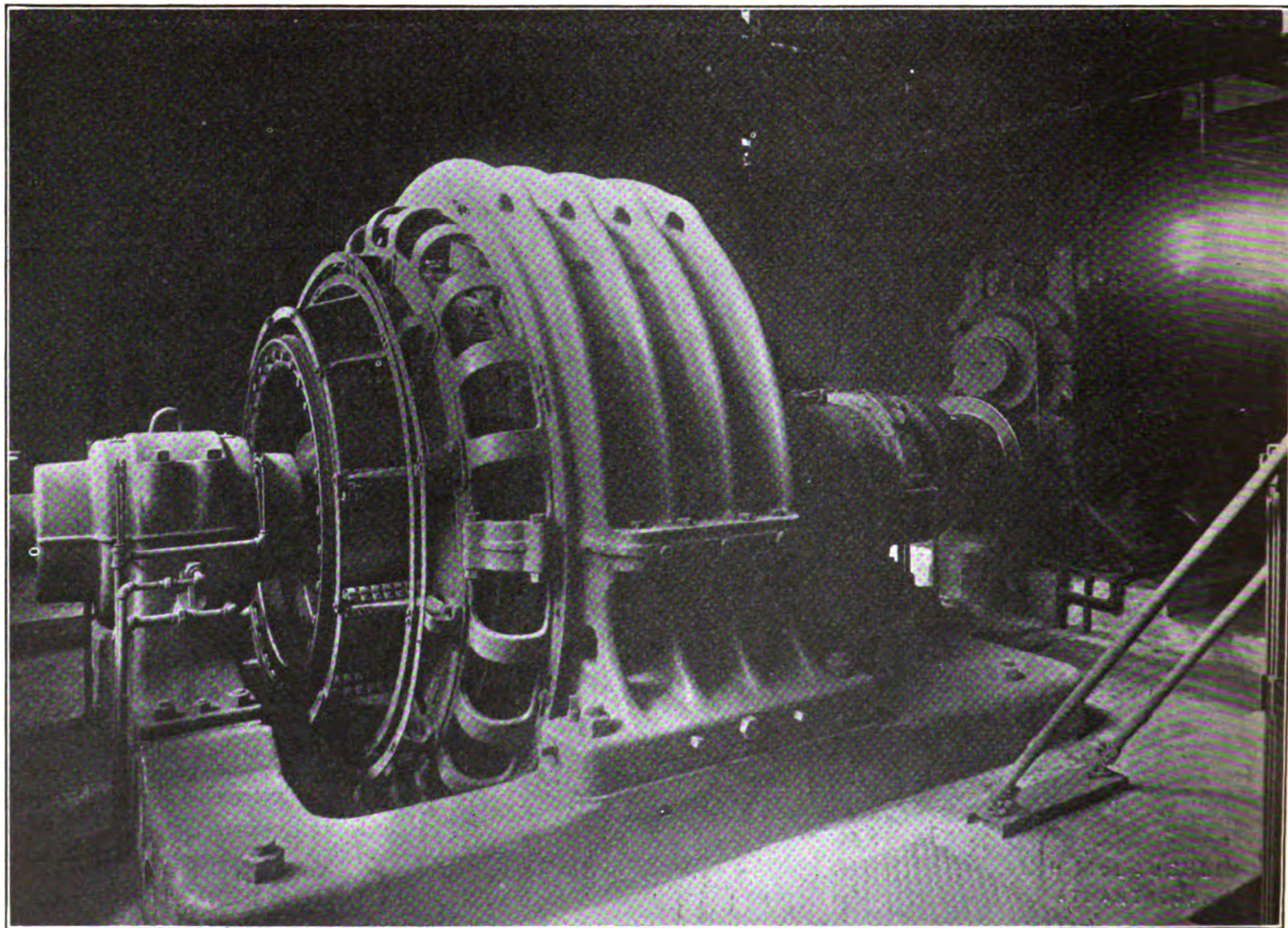


FIG. 9—New electric drive for blooming mill. This reversing motor has a speed range from 0-150 r.p.m. and a peak power of 5000 h.p. current is supplied at 600 volts d.c., from a motor-generator set equipped with a 35-ton solid steel flywheel.

CURRENT REVIEW

Business Navigation

Imagine yourself on a large ocean liner intent on keeping a business appointment in Liverpool in six days. The conference is vital to your business; but you know the captain of the ship has charted his course and you have confidence in his ability to bring his ship into port on time. The captain, in turn, knows the speed of his vessel and has confidence in his knowledge of the direction and velocity of wind and tide. Forecasts of weather conditions are received over the radio. Nevertheless he finds it necessary to take observations several times a day to check the estimated progress of the ship with its actual position. By doing this he can keep to his course and can better hold to his time schedule. Both the passengers and the crew have confidence in him and take a personal interest in the ship in so far as they understand the method by which it is navigated. You never doubt that the ship will dock on time for your conference.

Our ship of state must have the confidence of its passengers—the citizens; and the captain, like the sea captain, must take observations. No ship can sail blindly. Its course must be planned and its progress governed by that plan. The ship of state ran an uncharted course until 1921. At that time budget machinery was put on the bridge to serve as the eye and ear of the chief executive. It has brought about a better co-ordination of the various departments. It has aided the heads of government in more accurately planning activities and estimating needed appropriations. In addition, according to General Charles G. Dawes, it has made possible in one year the saving of \$250,000,000 which otherwise would have been spent.

"Business methods for the government" was a slogan frequently heard before the Federal budget law was passed. Today a new slogan is current, "Budget methods for business."

The practicability of the budget in business navigation is well shown by the experience of companies operating under it. The New England Telephone & Telegraph Company in 1921 began its field budget system which has now spread to every part of the business. Not only the company itself, but each division, district and local unit has its own budget committee. Each knows its own needs and estimates its own requirements, taking local business conditions into account. Forecasts of general conditions affecting the company are sent each local unit so that the effect of these conditions may be properly calculated when the local budgets are prepared, and finally, as is stated in the company's memoranda for budget committees, "by thus first planning and then seeing the results of our plans we develop an understanding and pride in our business and our management which, in turn, lead us to freely and fairly explain to our

patrons our plans and methods. Both employees and patrons are thus encouraged to understand and to assist in properly assisting local revenues, expenses, and construction programs with the service requirements of the communities involved."

Budgeting Usually Successful.

Business navigation with the budget is not limited to the telephone industry, however. It is applicable to hotels, railroads, mines, department stores, and manufacturing concerns just as well. The bureau's contacts with each of these industries indicate that budget practice is successful where it has been fairly tried out.

Impressed with the value of budgeting and the desire on the part of business executives for information on this subject, the Bureau took steps to fill the need. A series of business leaflets on management practices was prepared. Seven of them have already been released for distribution. Sample budget programs for nine industries are now available as follows: Railroad, public utility, hotel, garment, newspaper, construction and contracting, ice cream, department store, metal products.—Executives Service Bulletin.

Pulverized Fuel

Almost unnoticed in Great Britain, in the past year or two a revolution has been effected in the methods of steam generation in the United States, especially for large power station boiler plants, by the successful application of pulverized fuel. One of the principal factors in this achievement has been the perfecting of the "Lopulco" system, which, while retaining all the long admitted advantages of pulverized fuel firing, has completely eliminated the disadvantages of "slagging;" that is, the deposited ash becoming molten in the furnace, and the wear and tear on the brickwork. Already over 1,000,000 hp. is being generated in America with pulverized fuel, and some of the largest and most famous stations in the world are adopting it throughout, or have already done so, such as the Lakeside plant, Milwaukee, the River Rouge plant of the Ford Motor Company at Detroit, the new Cahokia plant at St. Louis, and now one of the huge Detroit Edison plants, the Trent Channel installation.

The plant now being erected at the Vitry (Paris) power station of the Societe Anonyme Union d'Electricite of Paris is particularly significant because, as is well known, this company have just completed the huge Gennevilliers station, the largest outside America, which is equipped throughout with mechanical stokers. After a very thorough investigation of "Lopulco" installations in America, however, the engineers of the company have already decided upon pulverized fuel in preference, and a further interesting point is that this Vitry station, when completed, will have the largest water tube

boilers, and the first modern pulverized fuel installation in Europe.

A diagrammatic outline sectional drawing of the Vitry installation is shown in Fig. 1. This consists of four huge water tube boilers of the American "Ladd" design, now being constructed in France by the well-known firm of Messrs. Delaunay-Belleville; the heating surface, together with the super-heaters, being 16,678 sq. ft. for each unit. There is also provided with each boiler a steel tube economizer of 9,684 sq. ft. heating surface, the combined heating surface of the boiler, super-heater, and economizer unit being therefore 26,362 sq. ft.

The normal rated evaporation of these units is 140,580 lb. water each, from and at 212 deg. F., but the guarantee includes a heavy overload for a continuous period of 4 hours of 210,870 lb. water from and at 212 deg. F. corresponding to 8.4 lb. from and at 212 deg. F. per sq. ft. of boiler heating surface at normal load, and 12.6 at maximum load.

It may be stated that the average British power station boiler is 50,000 lb. evaporation per hour, although a few 100,000 lb. boilers have been installed; while the "Stirling" boilers at Gennevilliers, at present the largest in Europe are about 132,000 lb. evaporation.

In the Vitry installation, in the first place the compactness of the arrangement will be noted, the ground space being extremely small, the pulverizing of the coal being carried out in front of the boilers and the pulverized coal stored on the top, the total radiation losses being estimated at not much over 1 per cent because of the enormous evaporation. The coal is first crushed, and passes over a magnetic separator to remove all particles of iron, being then delivered to the main overhead crushed coal bunkers in front, as illustrated. The crushed coal will then fall as required through "Usco" waste heat gravity driers on the latest principles, in which the drying of the coal is carried out in the most efficient manner by using a portion of the hot exit flue gases in the chimney base. This drier, of which one only is required for each boiler, consists essentially of a vertical compartmented cylinder, and the coal travels through continually by gravity direct to the pulverizer underneath. The coal therefore simply falls through the whole system by gravity from the coal hopper, through the drier and into the pulverizers, and the rate of travel of the fuel is controlled automatically by the speed at which the pulverizer works.

A motor driven variable speed exhaustor, fixed on the top of the boiler, draws the hot gases through suitable trunking from the chimney base, up through the descending coal in the drier, and delivers the exit gases to the chimney again at a higher level, the speed of the gases being adjusted as required. Air valves are also included in the circuit, so that a supply of cold air enters along with the hot gases, and the temperature of the mixed drying current as actually entering the base of the drier is not allowed to exceed about 215 deg. F. As a result the coal is dried as required down to about 2 per cent moisture, with practically no loss of volatile matter, which by ordinary methods of drying is often as much as 1 per cent of the weight of the coal. The amount of hot exit gases required is approximately 10 per cent of the total chimney discharge, and the power taken by the fan is almost negligible, representing a great improvement on the ordinary separately fired rotating driers used, which absorbed the equivalent of about 1 per cent of the coal dried.

The pulverizers are of the standard ball pattern, situated almost directly under the vertical driers, and

one pulverizer, with a normal capacity of 6 tons of coal per hour delivered, of a fineness on test of 95 per cent through a 100-mesh screen (100 holes per linear inch), and 80 per cent through a 200 mesh, is supplied with each boiler. These ball pulverizers are claimed to be so reliable and efficient that it is only necessary to supply one installation to each boiler, there being no more fear of breakdowns than with an ordinary mechanical stoker.

As fast as the coal is pulverized, it is exhausted from the pulverizer through a short trunk by means of a motor driven exhaustor just above, and discharged through a long vertical trunk right to the top of the installation, through a cyclone separator. From here it falls down, through a screw conveyor, into the pulverized coal bunkers above the boiler plant and the pulverized coal then passes out of the bottom of these bunkers to the duplex "Lopulco" coal feeders which supply the pulverized fuel, mixed with air, to the actual burners. Each boiler has five of these duplex feeders side by side, the whole installation of four boilers having therefore 20 feeders.

The "Lopulco" coal feeder consists essentially of an attachment to the bottom of the pulverized coal bunkers, in the form of a horizontal chamber containing a cast-iron screw feed driven through gear wheels by a small variable speed motor, so that the coal supply can be adjusted as required. The screw conveys the pulverized coal to the end of the feeder, where compressed air at about 12 in. wg. is supplied, and at this point there is a series of very rapidly revolving paddles, so that the air and the pulverized fuel are intimately mixed and pass direct down a small vertical delivery pipe, direct to the burners. The air used up to this point is only intended as a conveyor for the pulverized fuel, and amounts to about 10 per cent of that required for total combustion.

On the circuit secondary air is taken in, which has been heated by having passed through the hollow brickwork of the furnace walls, this supply—about 90 per cent of the air required for combustion—being controlled by means of adjustable shutters so that the combustion at the burners is under perfect control.

Each boiler is fitted with "Lopulco" burners, so that the whole installation is 40 burners, of the latest triplex design, consisting essentially of three rectangular chambers having a 3½-in. nozzle, the flame being directed downwards into the main body of the very large furnace chambers and then passing upwards through the boiler tubes, the total furnace volume being very great.

One of the most valuable accessories of the "Lopulco" system, to which much of the success is due, is the "water screen," in the bottom of the furnace, as illustrated in Fig. 1, consisting essentially of a series of steel tubes, about 4-in. diameter, through which the water in the boiler circulates; an invention which has completely eliminated slagging troubles, hitherto one of the chief difficulties of large scale pulverized fuel firing. Another valuable feature is the hollow firebrick construction throughout, cooled by the circulation of 90 per cent of the air required for the burners.

The guarantee of the performance of the plant is the very remarkable one of 84 per cent efficiency, based on the higher or gross heating value of the coal. The amount of pulverized coal to be burned will be 12,800 lb. (5.7 tons) per boiler per hour at normal evaporation, and 19,700 lb. (8.8 tons) at maximum, corresponding to about 10.9 lb. of water from and at 212 deg. F. per lb. of coal, the coal used being about 12,000 Btu. higher value.

The remarkable efficiency of the "Lopulco" system of pulverized fuel is best illustrated by the figures of the Lakeside power station of 40,000 kw. at Milwaukee, started up in December, 1920, the first large plant in the world to run on pulverized fuel.

The efficiency of boiler plant is 84-86 per cent week in, week out, all the year round, with only 20 per cent excess air over the theoretical; while the total auxiliary power throughout, handling, crushing, drying and pulverizing is only 1.75 per cent of the steam generated using rotary driers, although at Vitry the figure will be less than 1 per cent because of the new vertical driers. As regards wear and tear, the figure after grinding over 200,000 tons of coal at the Lakeside plant is about 2.0 pence per ton, actually less than mechanical stoking, and the labor costs are 1s. 2d. per ton, equivalent to British conditions, also less than mechanical stoking. Finally, pulverized fuel has made possible the working of water tube boilers of 350,000 lb. evaporation per hour, and over, and the entire control of the working of a boiler from a panel switchboard at a distance.—*Engineering and Boiler House Review, London, Eng.*

Workers' Suggestions

An index of the effectiveness of the system which rewards workers for suggestions is found in the recent compilation made by suggestion committees operating in plants of the General Electric Company.

Of the 8,078 suggestions reviewed by the various committees in the works 1,752 were accepted. Awards ranging from \$1 to \$500 were paid to those whose suggestions were accepted, making a total of \$22,988 paid out in cash awards during 1923.

Briefly, the operation of the suggestion committees is as follows: Suggestions for improvements are focused through a small committee in each works. This committee investigates the suggestion, passes upon the merit of it, and makes the award to the man or woman who made the suggestion, or explains why the suggestion cannot be effectively adopted. In most cases the award can be made within a period of a few weeks after the suggestion is received; where it is necessary to put the suggestion into practice in order to determine its value, a longer time must elapse. The nature of the suggestions have a wide range from additional protective devices to new methods of working materials, and include new methods of following production, as well as improvements in plant publications.—*General Electric Bulletin.*

Concrete

A hundred years ago, Joseph Aspdin, a mason in an English town, got an idea. It led him to experiment. In time he produced a fine powder, which when mixed with water into a paste and allowed to stand would "set", forming a hard substance. This substance so resembled the building stone from the Isle of Portland that the powder was named Portland cement. As years passed, rocks, clays and marls were found in many countries from which Portland cement could be made. The industry took root in Pennsylvania and Indiana in 1872. A third of a million barrels were made in the United States in 1890; in 1923 more than 137,000,000 barrels were produced by 126 mills, for which the manufacturers received about \$240,000,000.

"Concrete" is the name of many substances made by mixing ingredients. Among engineers, architects and general contractors, however, it has for several years meant usually one kind of substance, mixtures of Portland cement with water, sand and gravel, crushed stone, slag or cinders. There have been other kinds of hydraulic cements, and there are now, which are or have been used in making concrete.

Hydraulic cement concretes have several remarkable properties which have led to widespread use. They will set and harden under water. When freshly mixed, they are easily poured or packed into molds of almost any desirable form. They can be used with steel so as to combine economically the great tensile strength of this metal with stonelike resistance to crushing. Concretes are very resistant to fire when made of suitable materials.

Concretes have been used for almost every purpose for which stones and bricks have been used and for many more. For years users of concrete thought it could be mixed and placed according to simple rules by unskilled labor with little supervision. But the use of concrete was extended to more elaborate structures—especially reinforced concrete (combinations of concrete and steel). Factories, office buildings, houses, bridges, dams, pipes, and highway pavements demanded for economical and structural reasons higher development of the strength possibilities of the materials, greater dependability and more intelligent adaptation to specific purpose.

No longer was it sufficient to mix concrete by rule-of thumb from any likely looking sand and stone. Concrete mixtures must be designed. But data on which to base designing did not exist; engineers began collecting them from experience "on the job" and from laboratory experiments. In 1914, the Portland cement manufacturers took a hand in these investigations the Structural Materials Research Laboratory was established at Lewis Institute, Chicago. Since then several hundred thousand tests have been made there.

Several factors are involved in the making of concrete, the ingredients, their proportions, the mixing, the placing and the curing. Each has a large influence on density, strength and durability. The quality of each ingredient is important, cement, water and aggregate, by "aggregate" meaning sand or stone dust, and gravel, crushed stone, or other substances, mixed with the cement and water. Kinds of aggregates are numerous and various. For example, the laboratory mentioned has 2800 samples of different sands.

Sizes of aggregates and the proportions of the various sizes must be determined to suit the purpose for which the concrete is to be used. Sets of wire sieves with square meshes were found convenient for controlling the grading of the aggregates. Tests showed a relation between sizes and grading of aggregates and the strength of the concrete. Hence, one element in the designing of concrete mixtures was determined.

Further investigations brought to light two more important facts: (1) The quantity of mixing water should be the smallest which will produce a concrete sufficiently plastic for proper placing in the molds or forms; (2) The concrete must be cured under favorable conditions during its first few days (for example, it must have sufficient moisture for the hydration of the cement, which constitutes setting and hardening).

Strength of concrete was found to depend upon the ratio of the volume of mixing water to the volume of cement. So long as the mixture is workable, the less water, the stronger the concrete. "Sloppy" mixtures frequently sacrifice three-fourths of the possible strength.

A most important process occurs after the concrete has been "placed", the hydration of the cement, which transforms the plastic mass into a rock-like substance. As the word "hydration" signifies, the cement takes up water, which must be provided in suitable quantity. It has been possible to increase the wear resistance of concrete 65 per cent by providing proper moisture during the first 10 days of hardening.

For some engineers and architects there is little that is new in these paragraphs. But how many persons who live and work in concrete structures, travel through concrete-lined subways and tunnels, drink water conveyed through concrete-lined subways and tunnels, drink water conveyed through concrete aqueducts from behind concrete dams, and ride on concrete highways have any suspicion of the scientific research back of the cements and concrete?—*Cement Association.*

British Iron and Steel in 1923

Total Pig Iron Production Has Tripled in Two Years

By A. C. BLACKALL*

Notwithstanding the low ebb to which the British iron and steel trade had fallen in 1921 and 1922, great forward strides were made in 1923 and it is notable that there were over 200 blast furnaces in operation on December 31 as against 169 on the corresponding date in 1922.

Appearances all tend to show that the present year will even eclipse the figures of 1923, which in production of pig-iron were over 50 per cent greater than those of the previous year, while the steel output was considerably in excess of pre-war years. Last year showed Great Britain as the world's greatest exporter of iron and steel, ranking second only in amount of production to the United States. France's output of pig-iron for 1921 and 1922 exceeded that of Great Britain, which country, however, took first place in 1923, while Germany's figures were materially less than in 1922.

The building boom which has taken place all over the country and particularly in London has enormously increased the domestic demand for steel, while the considerable expansion in exports has had a wonderful effect on the output of the blast furnaces.

The total pig-iron production in 1923 amounted to 7,400,000 tons, against 4,900,000 tons in 1922 and 2,616,000 tons in 1921. The average monthly output for 1922 amounted to 408,500 tons against 616,650 tons for 1923, February showing the lowest production at 543,400 tons. That of May, at 714,200, was the highest after which production fell steadily until September. This was largely due to the unsettled state of Europe and the uncertainty attaching to the Ruhr developments, while the high prices demanded were additional factors tending towards the curtailment of business. After September, when production fell to 558,600 tons, a steady recovery set in and has continued until the present time.

This rapid recovery is all the more remarkable, since, generally speaking, conditions were entirely adverse to any improvement. For six months a boilermakers' strike paralyzed the shipyard industry, while both France and Belgium, due to their depreciated currencies and low costs of labor, were frequently not only able to successfully compete with British manufacturers for foreign orders, but also managed to sell considerable quantities of their productions to the British market as well. Nevertheless, the steel production in 1923 amounted to 8,600,000 tons against 5,832,000 tons in 1922 and 3,703 tons in 1921, and was approximately a million tons greater than the pre-war figures of 1913.

While approximately 750,000 tons of pig-iron were exported from the United Kingdom in 1923, imports amounted to 114,000 tons, total exports of pig and manufactured steel and iron being about 4½ million tons, or practically double the figures of any other nation. The future of the industry can be sized up in three words—cost of production. The war was responsible for enormous extensions of plants, resulting in greatly increased manufacturing capacity at low production costs. So long as these can be kept in check further expansions of the industry may be predicted with safety.

*London, England.

Finds Why Enameled Iron Ware Warps

Enameled iron ware is much more likely to warp if the iron and enamel have different rates of thermal expansion than if they expand and contract at the same rate, the Bureau of Standards finds. These made at the Bureau have also shown that warping is less likely to occur if the grease is burned off than if it is taken off with chemicals, and that warping is apt to result from sudden, irregular cooling or from failure to support the ware properly in firing. Thin metal is found to warp more easily than thick, but is more easily straightened.

The enamel used on such ware has for its chief ingredient a form of glass which is finely ground and mixed with other materials to form a paste which is applied to the surface of the metal, dried, and fired. The firing causes the glass to melt and adhere to the metal, while the other ingredients are dissolved in it. Warping sometimes occurs when the ware is cooled to room temperature after firing.

The tests were made on commercial enamelling steel and sheet iron which was furnished by a number of manufacturers. The material was cut into 16-inch squares and the effect of different variables in the enamelling process tested. Warpage was determined by allowing the test piece to rest on a flat base and measuring the areas included between the base and the test piece on vertical planes at five evenly spaced cross sections. The warpage was expressed as the average of the five areas.

W. T. Burt, aged 45 years, vice president of the Wheeling Steel Company, Wheeling, W. Va., was killed on May 22 in an automobile accident at Washington, Pa.

Following is a resume of some of the leading articles and trade reports appearing in Iron Trade Review, May 1 to May 29:

May 1.

A sharp decline in output is the leading feature of market reports at the beginning of May. Steel ingot operations in general are 65 to 70 per cent and prices lack stability. Iron Trade Review's composite of 14 leading iron and steel products this week is \$41.72, the lowest since January, 1923. Connellsville coke producers are reducing operations and wage reductions are being put into effect by coke oven operators. The Amalgamated Association of Iron, Steel & Tin Workers, has presented demands for an increase in wages for sheet and tin plate mill workmen averaging 25 per cent, and also for a 6-hour day. The demand made on the bar mill operators is for an average increase of 10 per cent.

A review of the automobile trade shows that average operations in Michigan plants have been reduced to about 80 per cent of the recent high peak.

The National Metal Trades Association at the 26th annual convention, New York City, appointed a committee to study human relations in industry. It is shown that 68 per cent of the members are training craftsmen.

May 8.

Pig iron production in April fell to 3,226,401 tons compared with 3,465,389 tons in March. Average daily output fell from 111,787 tons to 107,546 tons, or 3.28 per cent. The decline for output by steel works furnaces was 236,155 tons, while merchant output was reduced on 4,912 tons. Approximately 35 blast furnaces were taken from the active list in April.

The composite of iron and steel prices this week is \$41.58, compared with \$41.72, showing a little more stability in prices. Carnegie Steel Company has put out six more furnaces, and its ingot operations, after going down to 52 per cent, are again higher. Sheet mill operations in the Mahoning Valley this week are the lowest since March, 1922. Lake Superior iron ore operators have revised their estimate on shipments for this season from 60,000,000 tons to 50,000,000 tons. The market is extremely dull. A feature of Iron Trade Review's staff cablegram from London this week is to the effect that German mills have sold ship plates on the Cylde at \$4.39 per ton under the British producer's price. French production of iron and steel in March, 634,000 metric tons of iron and 573,000 tons of steel, was the largest of many months since the award. Canadian manufacturers are protesting the British government's proposal for reduction in the safe-guarding of industries tariffs. The proposal would remove preferential rates for Canada and place American exporters in a better position.

The description of the Henry Ford II, a new steel motorship, shows many departures from conventional design of iron ore carriers. All auxiliaries are electrically operated. The results of a survey of real importance and location of metal working industries in New York environments, are presented in this issue. This shows the importance of New York as a consuming center, is much greater than that as a producer.

The American Gear Manufacturers' Association, meeting at Buffalo, reports progress in the movement for standardization. The Society of Industrial Engineers also in session at Buffalo outlined its studies

and plans for cost reduction. Complete reports of both these conventions are presented in this issue.

May 15.

Steel ingot production in April fell to an annual rate of 40,500,000 tons, a decline of 23.6 per cent from an annual rate of 50,000,000 tons in March. A reduction amounting to 574,360 tons in the Steel Corporation's bookings at the end of April is the largest in percentage in a single month in many years. The Corporation this week is operating under 70 per cent of ingot capacity, while the industries average 60 per cent. Iron Trade Review's composite of 14 leading iron and steel products this week shows a decline of only 2 cents, now registering \$41.56. The most important item in the week's transactions is that relating to bookings in rails, estimated at about 2,500,000 tons for all makers. Leading iron and steel producers say they are not considering wage reductions at this time.

The pig iron situation shows some bright spots for the first time in many weeks. Buyers are beginning to negotiate for larger tonnages. The amounts actually placed are small and prices continue to recede.

An article by John D. Knox, technical editor representative of Iron Trade Review, gives the complete description of recent developments in the scattering of slag by Hydraulic means.

This issue contains a comprehensive summary of the proceedings of the 12th annual meeting of the Chamber of Commerce of the United States, presenting an address by Herbert Hoover, a feature of the meeting in which he urges manufacturers to adopt higher standards for business conduct to avert further regulation by government.

May 22.

Prices of pig iron and steel are lower. Semi-finished material is \$1 to \$2 under recent levels. Practically all districts report recession of 50 cents to \$1 on pig iron, accompanied with a greater display of interest by buyers. At Buffalo, inquiry is suddenly swollen to 35,000 tons. Some Buffalo furnaces quoted as low as \$19.50. Iron Trade Review's composite of prices this week is \$41.22, in contrast with \$41.56 last week.

The most important feature of the market this week is the fact that pig iron, made in the Netherlands, is being sold for delivery to Philadelphia and also to San Francisco, amounting this week to approximately 15,000 tons. British producers of galvanized sheets reduced prices making it possible to land the material at New York \$20 a ton under the American domestic price.

May 29.

This issue of Iron Trade Review contains accounts of eight conventions of metal working industries. Among them are the meeting of the Iron & Steel Institute at New York, the National Supply & Machinery Dealers Association, the Southern Supply & Machinery Dealers Association, The American Supply & Manufacturers Association at Cleveland, the National Association of Manufacturers at New York, the National Machine Tool Builders Association at Buffalo, the American Society for Steel Treating at Moline, Illinois, the National Pipe & Supply Association at Cleveland and the National Association of Purchasing Agents, at Boston.

The POWER PLANT

Economical Operation and Maintenance of Boiler Furnaces*

By ROBERT JUNE†

PART II

THERE are only two essential elements in the fire clay from which our furnace refractories are made. These are silica and alumina. All other elements and combinations such as lime, magnesia, iron, titan acid and the various alkalis may be properly classed as impurities.

As it is not practicable to separate the impurities from the silica and alumina, we find that there is a wide variation in the properties of the various commercial fire brick. While this is due primarily to the

This is the seventh in a series of articles by Robert June, who is well qualified to write on this subject. The articles are written from the point of view of the managing executive and deal with the dollars and cents end of power plant operation and maintenance. Succeeding articles deal with such live topics as safe and efficient boiler operation and maintenance, what management should know about coal and ash handling equipment, steam piping, efficient turbine operation, etc. The series is timely and should prove of value to our readers.

varying analyses of the several refractories, nevertheless analysis alone will not enable us to predetermine how a given fire brick will stand up in a given furnace. The resistance of the various bricks to the erosive action of the molten slag and ash, can, generally speaking, only be satisfactorily determined by experiment.

The best one can hope from an analysis is a negative result, that is, to show that certain bricks are unsuited to the work in hand. Bricks of apparently good analysis may not render satisfactory service due to their physical structure which is influenced by the manufacturing processes. The reason for this becomes apparent when it is understood that fire brick are made by combining certain proportions of the hard flint clays with varying proportions of soft or plastic clays; the hard clays forming in the main the heat resisting elements of the mass while the soft clays act as a binder and are the means of insuring physical strength.

Experiment is, therefore, our recourse to the selection of the refractory best suited for any given fur-

nace condition. If you are not getting satisfactory service from the fire brick you are using by all means try other kinds.

Methods of Furnace Construction.

The melting point of first-class fire brick is many hundreds of degrees higher than the temperatures encountered in present day boiler operation; therefore, direct fusion of the furnace lining is not our problem. What we do encounter is a softening of the fire brick structure at temperatures of 500 to 600 deg. below the melting point with a pronounced tendency toward erosion from the effects of molten slag and ash at these temperatures. Another factor encountered in the newer boiler room is the greatly increased height of the furnace wall with the consequent increase in pressure upon the brick. The effect of this pressure on the brick exposed to high temperature is very pronounced, greatly increasing the tendency to failure.

One of the principles, therefore, to be kept in mind in designing furnaces is that no unnecessary stresses

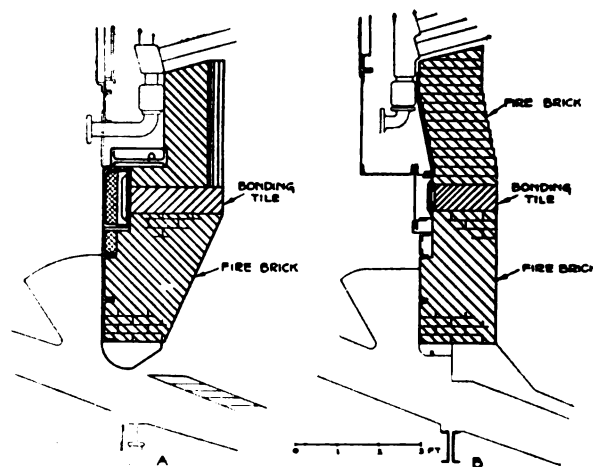


FIG. 1—Two methods of furnace wall construction.

and strains shall be put upon the brick. An excellent example of proper and improper design is furnished by Mr. E. B. Ricketts of the New York Edison Company, through whose courtesy we include the illustration in Fig. 1.

The wall at the left is corbeled in such a way as to impose a very heavy load on the course of brick just above the ram box caps. When this construction

*Copyright 1924, by Robert June.

†The Robert June Engineering Management Organization of Detroit.

was employed a softening of the lower rows of brick caused the whole front wall of the furnace to come tumbling down onto the stoker after a few weeks' use. When the furnace was rebuilt the method of construction shown at the right of Fig. 1 was employed with the result that this part of the furnace has given continuous satisfactory service for a number of years.

It may be set down as an axiom that the wall which leans in toward the fuel bed is a constant source of trouble and that the wall which is corbeled away from the fuel bed is the most satisfactory.

Flat Suspended Arches.

One of the most important factors in the reduction of furnace maintenance cost has been the development of the flat suspended arch. Sprung arches are an expensive proposition to erect, the buckstays and tie rods require special attention. Despite the best provisions there is buckling of brickwork and when

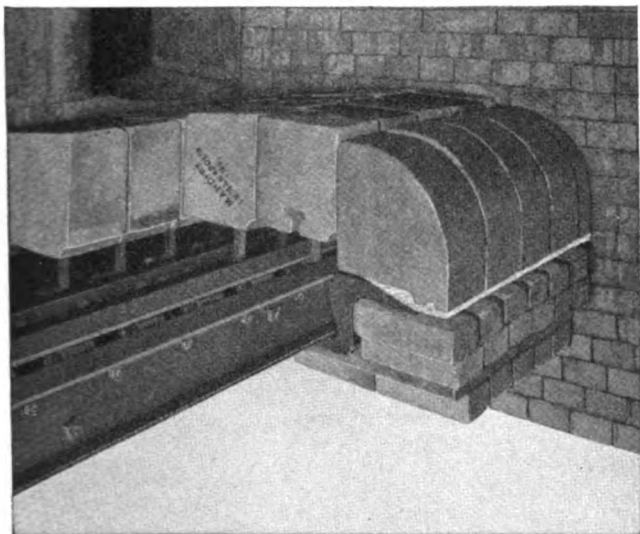


FIG. 2—Suspended arch showing nose tile construction.

repairs must presently be made it is usually necessary to tear down considerable sections of the wall in order to repair the arch.

With the flat suspended arch all this trouble is eliminated. The whole arch is constructed on the unit principle so that any one piece can be removed and replaced at a minimum loss of time and at a minimum expense. There is practically no time out for shut-downs—an important point where the operations of expensive equipment and highly paid labor must be suspended due to the fact that power or steam in necessary quantities cannot be supplied, owing to the necessity of repair of the furnace arch.

In addition to this direct saving in time and expense, the use of the flat suspended arch results in better combustion conditions due to the large furnace volumes possible and the even distribution of the gases. This saves fuel and increases efficiency.

Characteristics of the Well Designed Flat Suspended Arch.

The following general features will be found in the well designed flat suspended arch:

1—Any individual tile can be replaced in 15 minutes without disturbing any other tile. It is not necessary to tear down considerable parts of

good tile or a curtain wall in order to replace a few burnt ones.

2—Each tile hangs vertically on a separate bolt like a plumb bob so there is no strain on the neighboring tile.

3—The nose tile in particular can be removed without disturbing any other tile or without disturbing any of the curtain wall above.

4—Expansion of the arch is taken up by allowing the nose tile to swing upward on its bolt in such a manner as to cause no strain or pressure upon the other tile.

5—The arch is well supported by steel work, each row of tile being suspended on a separate pair of channels or I-beams, distributing the load evenly over the walls.

6—A separate support for the curtain wall is provided. There is thus no need to disturb the nose tile or arch proper, as the curtain wall is a separate and distinct unit.

7—The supporting steel work is adequately ventilated without in any way admitting air to the furnace.

With the flat suspended arch as each tile is hung on its own bolt free from any strain or from the weight of any other tile or brick, the tile will not break off, but will remain in place even if burned more than two-thirds through and such tile as burn are easily replaced. The illustrations show how it is unnecessary to tear down any but the tile that is to be replaced. The services of a high priced bricklayer are not required and anyone who can handle a hammer and chisel can readily replace the tile.

Inequalities of burning in the tile can be taken care of by the use of bolts of varying length so that tile which are partially burned may be continued in service even when new tile are put in alongside, by the insertion of shorter bolts in the new tile, bringing surfaces exposed to the heat to the same level.

The flat suspended arch is particularly adapted to the burning of bagasse, wet tan bark, wood refuse, hogged fuel, sawdust, etc. In installations of this character the fuel is generally admitted through openings through the arch in the roof of the furnace. By using longer or shorter bolts the contour of the arch can be specially adapted to the characteristics of the refuse being burned. Radiation can be so directed that the moisture is quickly driven off, and high combustion rates maintained.

Baffles.

There has been great improvement in baffle design and construction within recent years. The weaknesses and limitations of brick baffles have long been recognized and modern practice has tended more and more toward the use of baffles of what may be termed monolithic construction. The three important advantages resulting from this type of construction are: First, that the baffle is gas tight; second, that it is durable; third, that it can be built in any desired position. This last feature has made possible the betterment of furnace design and relief from many specific operating difficulties.

In the use of this type of baffle the following general principles have been found most effective:

1—In general the passes of the boiler are tapered on the principle of reducing the volume to correspond to the reduced volume of the gases

due to their shrinkage, as the temperature decreases.

2—Securing a low entrance velocity of the gases, thus aiding the draft and tending to relieve accumulations of slag on the tubes.

3—Exposing a large area of the bottom rows of tubes to the radiant heat of the furnace. In general providing for maximum heating surface in the first pass of the boiler.

4—Placing baffles so they will prevent accumulation of soot.

5—Increasing combustion volume by moving back bridge walls and at times inclining them backward for the sake of rigidity and longer life.

Monolithic curtain walls may also be installed to excellent advantage in many furnaces. Where brick curtain walls are employed in horizontal water tube boilers these are usually of the standard 9-inch thickness and the walls are supported at the bottom with a cast iron beam carried in the side walls of the furnaces. In a construction of this sort it is difficult to make a tight joint between the bricks, which are square, and the drums, which are circular; with the result that there is very apt to be considerable leakage through the curtain wall at this point. Such leakage is serious since the gases go from the top of the second pass directly to the stack instead of passing through the second and third passes as they should.

In order to meet this situation the monolithic curtain wall has been introduced and has been found to render satisfactory service. Leakage is prevented and it has been possible to reduce the thickness of the curtain wall from 9 in. to 4 in. with a corresponding decrease in the weight to be supported as well as a slight increase in the volume of the gas chamber.

Relining.

As a general proposition boiler furnaces are not inspected and repairs made at close enough intervals. Frequent attention to minor repairs may save in costly shut-downs and complete rebuilding of the furnace walls. The time to make furnace repairs is when the boilers are down, as they usually are at regular intervals for internal inspection and cleaning. Then is the time to go over the walls, linings, arches, bridge walls and baffles and put them in proper condition. In inspecting furnace walls pay careful attention and keep a sharp look-out for any signs of bulging. This is especially to be watched for where the walls are high or the brickwork carries part or all of the weight of the boiler. If the boiler is supported by an independent steel structure see that this structure is properly protected at all times. In a case which recently came to our attention the supporting structure for the boiler had been so badly damaged by heat that the entire furnace had to be torn down and a new steel structure put in, thus causing the loss of the use of the boiler for a number of weeks and a very large repair expense, all due to carelessness.

In inspecting the lining tear out any parts showing signs of weakness without waiting for complete failure of the part. In making such repairs thoroughly clean the openings caused by the removal of the bricks and wedge the new brick in tight.

In stoker fired boilers see that the inspection doors are lined with fire brick or tile and that such lining is kept in good condition. It is a very easy matter to warp inspection doors and once they are warped it is

next to impossible to keep them tight so that such doors may become an expensive source of air infiltration into the boiler setting.

After inspection is completed and repairs, which have been noted, have been made, it is good practice to open the damper wide and close tight the furnace doors, then to go over the exterior of the setting with a lighted candle or torch so that any air leaks may be detected. In this connection a plastic cement coating on the boiler is recommended and in proportion to the expense involved in applying it, the returns will be found to be very high.

New High Pressure Power Plant

One of the most interesting and modern power stations recently built is that of the American Construction & Securities Company, Williamsport, Md., a general view of which is shown in Fig. 1.

The boiler house equipment consists of two Babcock & Wilcox cross drum type boilers, each of 1450 bhp., for generating steam at 350 lbs. pressure with 200 deg. superheat. Ultimately there will be 24 such boilers, giving a total capacity of 34,500 hp.

Only one 14,000-kw. Westinghouse generator is in operation, but eventually there will be five additional generators of 30,000 kw. each, or a total of 164,000 kw.

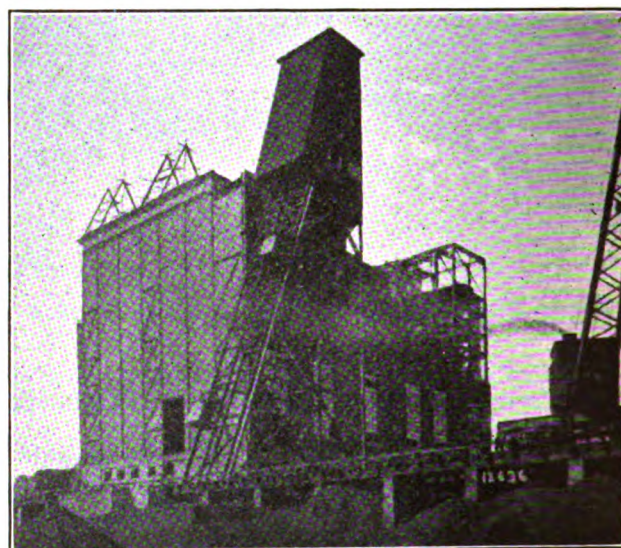


FIG. 1—General view of new power station at Williamsport, Pa.

Two Link-Belt "Clean Water" intake screens handle the condenser water for the present and will be added to as the plant enlarges.

The coal handling equipment installed consists of one 50-ton track hopper, equipped with automatic loaders, one automatic skip hoist with balanced buckets, one 10-ton auxiliary overhead hopper filter with reciprocating feeder, one two-roll crusher, one 24-in. belt conveyor with traveling tripper, one Merrick weightometer, coal bunker gates and stoker spouts. The overhead storage in front of each pair of boilers is at present of 600-ton capacity. This will be increased as additional boilers are installed.

After a careful study of the requirements of this installation, the engineers, Sanderson & Porter of New York City, chose the skip hoist as the better

medium for elevating the coal, particularly on account of the high lift.

Coal is received by rail on an elevated track and is either dumped directly into the 50-ton track hopper or dumped from the trestle and stored by a locomotive crane. The present outside coal storage capacity adjacent to the plant is about 5,000 tons. This storage will eventually be increased to 60,000 tons, at which time it will be served by a bridge tramway or a long radius locomotive crane.

The skip hoist has a vertical lift of 140 feet, the angle of the incline being 68 deg. from horizontal. With the speed of bucket travel of 200 ft. per min., the hoist has a guaranteed capacity of 150 tons per hour. Under actual test, however, it has exceeded this guarantee.

The hoisting operation is continuous, the skip buckets being automatically loaded at the track hop-

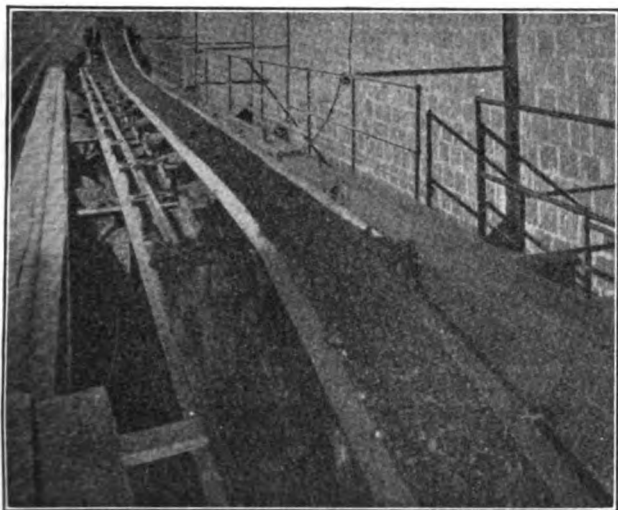


FIG. 2—Coal distributing belt, 24-in. with, which conveys the coal from crushers to storage bins.

per and discharged in the auxiliary 10-ton overhead hopper. After being crushed, the coal is distributed over the 600-ton storage by means of the 24-in. belt conveyor (Fig. 2), being weighed and recorded by the Merrick weightometer.

In the development of this plant the present equipment will practically be duplicated. The entire skip hoist, including the structural steel, was designed and manufactured by the Link-Belt Company of Philadelphia.

Brooke Combustion Controller

Changes in load on boiler cause the steam pressure regulator to open or close the stack damper. This produces a change in draught over fuel bed, which actuates our controller. The controller then proceeds to open or close the blast gates, until the predetermined draught has been restored.

This controller consists of two inverted bells, enclosed in separate chambers, and sealed with oil. Furnace draught is piped to the under side of one, and the upper side of the other. Atmosphere is admitted above the first, and below the second. Due to this balancing of the bells, possible changes in oil level have no effect on accuracy or sensibility. The bells are connected to an arm which passes through the oil

chamber above the levels of the oil, so that all packed joints are avoided.

Rigidly connected to the pivot, but outside the oil chamber, is a threaded arm which carries the electrical contacts. A slight tipping of the bells forms a



Brooke Combustion Controller.

contact on one side or the other, and this actuates a magnetic contactor, throwing the reversible motor across the line. The motor starts forward or backward, as occasion requires, and operates through a powerful gear train. Pulleys on the main shaft give the final drive. The electric motor gives a positive drive in both directions, and being a constant speed motor, will not slow up the action through friction in the damper.

This controller will maintain the draft constant at any predetermined point, with very slight variations. It will prevent the formation of positive pressure over the fuel bed, which does great damage to settings and arches. It will give a correct supply of air whether the fuel bed is thick or thin, and in case of an incipient hole in the fire, will not force air through, thereby making the condition worse, as any control will do in which the steam pressure regulator actuates the fan first, or where there is a mechanical connection between the stack damper and the fan.

Set Drafts by Composition of Flue Gases

An electrical method of gas analysis recently perfected at the Bureau of Standards of the Department of Commerce makes possible the immediate detection of the change in composition of flue gases in a boiler plant, the recording of such changes throughout the day, and the manual or automatic control of regulating apparatus in accordance with the gas composition. Other industries in which the new method is expected to prove useful are the manufacture of oxygen and hydrogen by the electrolytic method, the manufacture of sulphuric acid and of synthetic ammonia, and the extraction of helium from natural gas for use in balloons and airships.

This device and tests made of it are described in Technologic Paper No. 249 of the Bureau of Standards entitled, "Thermal Conductivity Method for the Analysis of Gases." Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 20 cents.

NEW EQUIPMENT

Rotary Flying Shear

The Buffalo Bolt Company, North Tonawanda, N. Y., recently installed a new type of flying shear at their 8 in. and 10 in. merchant mills for cutting rounds, squares and flats. This shear was designed and built by the United Engineering & Foundry Company, Pittsburgh, Pa., under a patent of Mr. Norman Rendleman of the Jones & Laughlin Steel Company who conceived the idea of shearing round, flat and square bars immediately behind the finishing stand of a rolling mill by means of two rotary knives set at an angle to the line of travel of the bar. In other words, taking a rotary shear and placing it at an angle with the line of travel of the bar leaving the mill and slipping the bar between the knives when a cut was to be made. Suitable speed of rotation of the rotary cutters combined with the angle at which they were set, would enable the shear to cut the bar without interrupting its delivery speed from the mill.

The shear consists of two circular cutters mounted on a suitable base and rotated at the proper speed by two adjustable speed motors each connected to the spindle of one of the cutters. Means is provided so that when a bar is to be cut, it is moved sideways until the cutters catch it. The rotating knives cut the bar without stopping its forward motion. The bar is then traveling on the opposite side of the knives and cannot be cut again until it is moved to its first position. This is done by raising the upper knife and moving the bar across the trough between the open knives. The upper knife is then lowered to cutting position and the shear is ready to repeat the cutting operation. A third motor is provided for raising and lowering the upper spindle. The shear is arranged with the cutters at an angle of about 45 deg. to the line of travel of the bar leaving the mill.

The whole operation is automatic and a complete cutting and resetting cycle requires about two seconds, and the shear will cut bars into any convenient length delivered in a time greater than this period. In other words, with a delivery speed of 1,200 ft. per minute,

the shortest piece which the shear will cut would be about 40 ft. It is claimed that it will cut bars at any delivery speed up to 5,000 ft. per minute.

As the cutters work at an angle to the line of travel to the bar, the cut will also be at the same angle. Illustration shows the appearance of a round and a flat after being cut. The bars were traveling from left to right when cut.



With the use of this shear heavier billets may be used with a moderate length of hot bed. The shear can also be used with equally good advantage in connection with reels when rolling rods, as the product of one billet may be fed into two or more reels as desired.

The illustration at the bottom of the page shows the shear as installed at the plant of the Buffalo Bolt Company. With this particular installation, the shear is not used when the bars are coiled. The shear has capacity to cut rounds or squares up to 1 in. and flats up to $\frac{3}{4} \times 2$ in. or $\frac{3}{8} \times 4$ in., and we understand larger sizes can be built to cut much heavier sections.

The advantages claimed for using the shear, are as follows:

- Heavier billets can be used for small sections.

- Labor saving in handling a less number of billets.

- Less crane time required to handle the same tonnage, due to using larger billets.

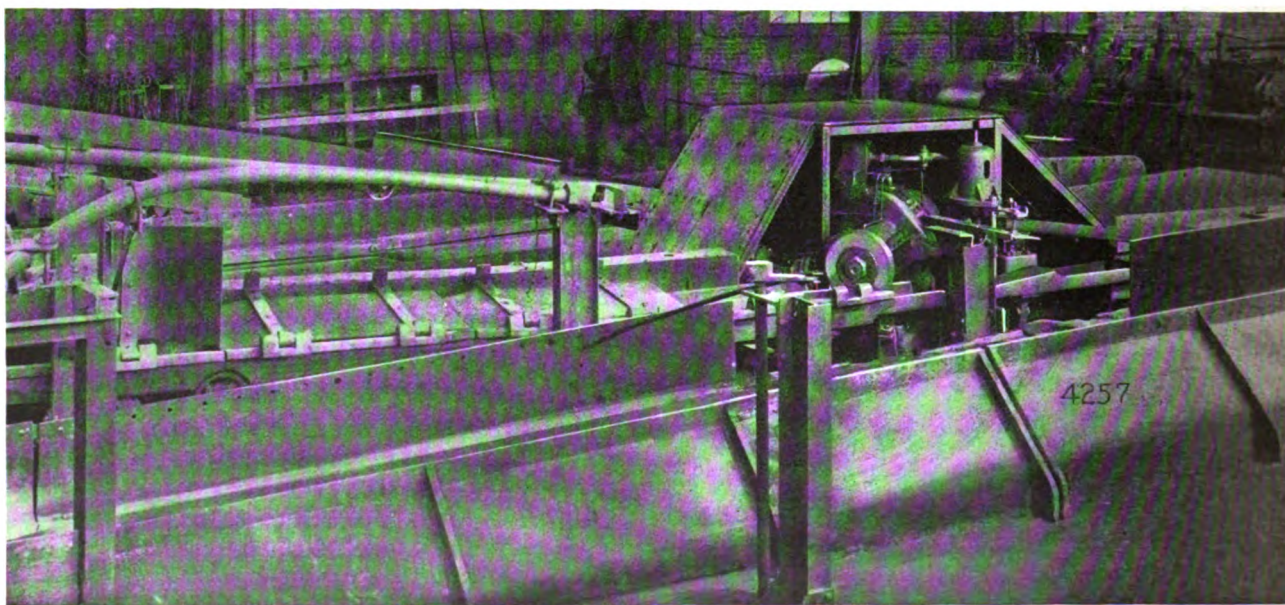
- Cheaper cost of raw material due to using larger and longer billets.

- Tonnage increased as the lost time between bars is proportionately reduced.

- Reduced scrap loss due to less number of billets.

- The work of the men on the various stands is reduced, and in some cases less men required, as there are fewer bars to be entered into the mill.

- First cost of mill buildings and hot beds can be materially reduced.



Trade Notes and Publications

The Centrifix Corporation of Cleveland, Ohio, is distributing a four-page bulletin describing its Centrifix steam purifier. Pictures of the device serve to illustrate this recent development in the art of better boiler operation. In a field where before engineering entered largely in the solution of any specific application, herein "steam purification has been reduced to a standard," and any standard boiler may be fitted with a correctly sized purifier regardless of variations in capacity or feed water characteristics.

The Morgan Engineering Company, Alliance, Ohio, are distributing several new and interesting bulletins. Bulletin No. 24 is devoted to standard cranes, pictures on the front cover, a Morgan 250-ton, 85 ft. 10 $\frac{3}{4}$ in. span crane in service at the Pennsylvania Railroad Company's Logansport, Ind., shops. Details of the many construction features which enter into successful crane engineering are gone into carefully and illustrated. Bulletin No. 28 pictures the extent to which punches and shears have been developed. A Morgan motor-driven guillotine plate shear, built for the Youngstown Sheet & Tube Company Indiana Harbor, Ind., plant is featured. Bulletin No. 29 is an excellent analysis of the safety limit stop problem and is worth reading and filing for reference.

"Modern Motors for Modern Appliances," is the title used to introduce two new bulletins being distributed by the Ohio Electric & Controller Company of Cleveland, Ohio. Ohio motors described here have been designed to meet the increasing demand for high grade motors for application to domestic appliances, pumps, machines and other devices which are operated from lighting circuits.

A very complete textbook on power transmission, and silent chain transmission in particular, has just been issued by the Ramsey Chain Company, Inc., general offices and factory Albany, N. Y., manufacturers of the chain with the compensating joint. It is a 6x9, 48-page book in two colors, beautifully illustrated and bound. It treats on the comparisons between the various methods of drives, leather and rubber belting, gearing, direct drives and silent chain. It also covers the transmission problems in the following fields: Textile, machine tool, punch presses, shears, wood-working machinery, fans and blowers, mixing machinery, grain elevators and flour mills, pumps and compressors, cement and clay working machinery, rubber plants, paper mills, steel plants, etc. It has complete engineering information and data for laying out silent chain drives. A copy will be sent free to any reader mentioning this magazine.

One of the largest contracts for electrical apparatus ever closed was that recently awarded the General Electric Company, Schenectady, N. Y., by the Jones & Laughlin Steel Corporation, Pittsburgh, for a 14-inch continuous steel mill at its Aliquippa works. The contract calls for 10 direct adjustable speed 600-volt motors ranging in size from 200 to 3,000 hp.; five motor generators with an aggregate capacity of 13,500 kw., and a number of mill type motors for mill tables, cranes, etc.

The Cleaton Company (Canada), Ltd., Eastern Canadian representatives of the Conveyors Corporation of America, 326 West Madison Street, Chicago, have moved to their new office at 1070 Bleury Street, Montreal, Quebec. The Cleanton organization handle the sale of American steam jet ash conveyors, American air-tight doors and other power plant specialties in Montreal and Eastern Canada. R. E. Cleaton is president and N. Bannatyne chief engineer of this well known organization.

The Diamond Power Specialty Corporation of Detroit, Mich., manufacturers of Diamond soot blowers for water tube and horizontal return tubular boilers, has appointed W. L. Sullivan, 505 Central National Bank Bldg., Tulsa, Okla., as their representative for State of Oklahoma. Mr. Sullivan has been in Tulsa for several years, specializing in the sale of power plant equipment and machinery.

The American Roll & Machine Company, Warren, Ohio, recently incorporated with a capital stock of \$300,000, will shortly begin the erection of a plant for the manufacture of chilled rolls. Officers of the company are J. C. Manternach, president American Welding & Mfg. Company, president; J. D. Estabrook, president Sunlight Electric Company, Warren, vice president, and R. E. Shook, Canton, secretary and treasurer. George G. Brader, N. C. Ralph and R. C. Day, Warren, and W. E. Blecker, Canton, are directors.

Straight Line Production

(Continued from page 267)

ward the furnace and carried back over the sand by the cast house crane.

The roller is now dragged over the sand leaving a series of perfectly molded imprints of pig bed and sow, each identical with the others and exactly spaced. The roller is not truly cylindrical but is more nearly a four equal sided figure whose sides are cycloids. Each side comprises a bed and carries a sow mold running the whole length with 28 pig molds attached thereto. The pig molds are so formed as to leave a minimum neck joining pigs to sow and to form a notch in center of pig to facilitate its being broken.

After roller has traversed the length of cast steel the bed is ready for the cast, the only hand work necessary being to connect the sows at their ends to the runner.

Pig roller iron is smoother, freer from sand and is more uniform in size than that made in hand-made beds. The individual pigs are a little lighter. For these reasons, foundries prefer it to the old type of pigs.

A Southern Rolling Mill

(Continued from page 294)

In view of the "Quality" aimed at, something has already been said of the measures taken for improvement. New equipment is constantly being added for bettering the product, both in mill and laboratory. The inspection force has recently been trebled. And these measures, together with the closer contact possible in a small plant, make quite feasible the realization of their aims to deliver the best steel obtainable in the shortest time possible.



Fred J. Mershon, for many years export sales manager of the Industrial Works at Bay City, Mich., has now taken entire charge of their Detroit branch office located in the Book Building.

William Wietelmann has been elected assistant superintendent of the plant at Zanesville, Ohio, of the Youngstown Sheet & Tube Company, Youngstown. A. L. Jones has been named superintendent of the Zanesville plant, succeeding F. W. Gordon, former superintendent, who resigned to assume charge of a tube mill in Chicago.

Frank W. Gordon, superintendent of the plant at Zanesville, Ohio, of the Youngstown Sheet & Tube Company, has resigned to assume charge of a new tube mill at Chicago to be operated by Clayton and Anson Mark. Mr. Gordon will be accompanied to Chicago by Frank Windsor, Harry Alden, James Mawhinney and Alex McClelland, department managers of the Zanesville mill who will be advanced to department heads at the Chicago plant. Albert L. Jones, who for the past several years has been assistant superintendent of the Zanesville plant, will succeed Mr. Gordon as superintendent there.

Roy H. Davis has resigned as a director and general manager of the Firth-Sterling Steel Company, McKeesport, Pa., and also as vice president and a director of the Globe Wire Company, owned by the Firth-Sterling Company. He is, however, continuing his association as a director of Thos. Firth & Sons, Inc., Hartford, Conn. Mr. Davis has been associated with the Firth-Sterling Steel Company since 1917. Last fall he spent several months at the works of Thos. Firth & Sons, Ltd., Sheffield, England, making a special study of stainless steel and its application for engineering purposes, especially turbine plates. He also has been in close touch with its development in this country. Previous to his association with the Firth-Sterling Steel Company, Mr. Davis was with the Washington Steel & Ordnance Company, a Firth company, in charge of munition work, having been located at the office in New York. He has made no definite plans for the future.

L. D. Albin, formerly general sales manager of the Ingersoll-Rand Company, 11 Broadway, New York City, has been elected vice president in charge of European sales of that company. Mr. D. C. Keefe, formerly assistant general sales manager, has been appointed to succeed Mr. Albin as general sales manager.

Charles Pettigrew, formerly superintendent of the Joliet, Ill., works of the Illinois Steel Company, and general manager of the Sparrows Point, Md., plant of the Maryland Steel Company (now a part of Bethlehem Steel Company), left \$100,000 to the Silver Cross hospital at Joliet, according to his will recently probated at Bridgeport, Conn. Mr. Pettigrew died at Pasadena, Cal., May 22, 1923.

Stanley A. Cullington of the Bond plant of the American Radiator Company, C. C. McDonald of the Wickwire-Spencer Steel Corporation, and John J. Ryan of the Automatic Transportation Company were among those elected directors of the Safety Club of the Buffalo Chamber of Commerce for 1924.

Mrs. Nellie Lowry, widow of the late Dr. A. C. Lowry, was elected president of the Marting Iron & Steel Company at Ironton, Ohio, March 19. Mrs. Lowry is a daughter of the late Col. H. A. Marting, and succeeds to the presidency which was formerly held by her husband. No other changes in the officials were made.

J. L. Schueler, metallurgist of the Keystone Steel & Wire Co., Peoria, Ill., has been appointed superintendent of the open-hearth department to succeed Alexander G. Black, who recently resigned to become superintendent of the open hearth department at the Vandergrift, Pa., works of the American Sheet & Tin Plate Company.

Thomas Williams has been appointed superintendent of the Thomas Sheet Steel Company, Niles, Ohio, formerly operated by the Brier Hill Steel Company, which was absorbed by the Youngstown Sheet & Tube Company at the time the Brier Hill Steel Company was taken over by the Youngstown Sheet & Tube Company.

Some Pointers on By-Product Coke Oven Operations

Carbon Monoxide Poisoning

Carbon monoxide, most common and insidious of poison gases, is continuing its frightful ravages on human life, according to a statement made by Dr. R. R. Syaers, Chief Surgeon, Bureau of Mines, Department of the Interior, before a meeting of the Pacific Safety Conference at San Francisco. In New York City several hundred deaths occur each year from carbon monoxide poisoning, due chiefly to domestic use of gas where sufficient care as to proper use of appliances and ventilation is not taken. Records from the State Department of Health of Ohio, which are said to be incomplete, show that 64 deaths and 113 partial asphyxiations occurred in that state during the winter of 1922-23. Fifty-five of the deaths were due to gas heaters and stoves and five to exposure to automobile exhaust gas.

Carbon monoxide is a gas slightly lighter than air, with which it diffuses readily. It will burn and has a wide explosive range. Like air, it has neither color nor taste and has no odor in concentrations usually encountered, therefore it can not be detected by the ordinary senses with which men are endowed. It is produced by burning carbon-containing fuels, as coal, wood, gasoline, natural and manufactured gas, etc., whenever not enough air or oxygen is supplied to burn the fuel completely.

The human race has probably been exposed to this gas since men first began using fires in confined or sheltered places. A number of cases described in the ancient literature indicate that carbon monoxide was a frequent cause of death by accident, suicide, and as a means of punishment or torture. Aristotle, who lived in 384-322 B.C., stated that "animals collapse from harmful odors, as man gets a severe headache and often dies through charcoal vapors." The Romans knew that smoke was poisonous, and used the greenest, most smoke-producing wood to put persons to death. The occurrence of carbon monoxide poisoning has increased in frequency through the years until at the present time it is found in the home as well as in many industries.

Common sources of carbon monoxide, illustrating its universal occurrence, are mine fires and explosions; the gaseous products of combustion of powder, dynamite and other explosives; blast furnace stack gas; coke oven gas; coal gas; producer gas; automobile exhaust gas; smoke from burning buildings, and railroad locomotive stack gas. Manufactured gas may contain anywhere from 10 to 30 per cent of carbon monoxide. If the connections with either heaters or lights are poorly made an added danger is introduced. The use of rubber tubing has been especially emphasized by many investigators as causing poisoning and often death of those exposed, due to deterioration of the rubber and to ill-fitting connections. Automobile exhaust gas contains an average of 7 per cent of carbon monoxide.

The detection of carbon monoxide is very important in order to avoid exposure. In concentrations

usually found carbon monoxide cannot be detected by its odor. However, in its occurrence from most sources carbon monoxide is associated with other gases having distinctive odors, and thus warning is given of a dangerous atmosphere. Removal of the odorous constituents from illuminating gas in scrubbing the gas is often the cause of poisoning to users through absence of warning odor. The odors coming from domestic gas stoves may or may not be a criterion for judging the presence of carbon monoxide.

Mice and birds are more quickly affected than men by carbon monoxide, and may be used for detecting dangerous atmosphere. Birds are preferable because they show symptoms earlier and are easier to observe.

The miners' flame safety lamp cannot be safely used for the detection of carbon monoxide in air, as it is difficult to detect with a safety lamp even the presence of 1.5 per cent of carbon monoxide. This percentage is exceedingly dangerous to life—in fact, a man breathing such an atmosphere would be overcome almost at once.

The "Hoolamite," or activated iodine pentoxide indicator for carbon monoxide, is frequently used by engineers of the Bureau of Mines engaged in mine rescue and recovery operations. The indicator gives immediate positive results with carbon monoxide in air in concentrations of 0.07 per cent or more. This detector has an advantage over the use of mice and birds in that a determination can be made in less than one minute, whereas it takes as long as 30 minutes before an animal will give an indication of gassing in, say, a concentration of about 0.1 per cent of carbon monoxide. No skill is required in making a determination.

The Bureau of Mines has recently devised a method whereby the blood solution, which is brought into equilibrium with the gas by shaking as described above, is quantitatively analyzed for carbon monoxide hemoglobin, and the amount of carbon monoxide in the air is determined in low concentrations to an accuracy of 0.01 per cent.

Copies of Serial 2593, containing information regarding carbon monoxide poisoning in homes and industries, and outlining methods of treatment of acute carbon monoxide poisoning, may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

The by-product coke plant of the Diamond Alkali Company at Painesville, Ohio, consisting of 23 Koppers Becker type combination coke and gas ovens, complete with by-product and benzol recovery equipment, was put into operation early this month. The plant will carbonize approximately 500 tons of coal per day. The coke, ammonia and part of the gas will be used in the chemical plants of the Diamond Alkali Company at Painesville and part of the gas will be sold to the gas companies supplying gas to Painesville and Ashtabula, Ohio.

NEWS OF THE PLANTS

The American Sheet & Tin Plate Company, Frick Bldg., Pittsburgh, Pa., has plans under way for extensions and improvements in its mills at Canton, Ohio, to include the erection of a new roll shop and several other structures, and the installation of considerable additional equipment, including several air furnaces. W. A. Harris is local manager.

The Bethlehem Steel Corporation, Bethlehem, Pa., has plans in progress for expansion and betterments at its several subsidiary plants, including the Lackawanna Steel Works, Buffalo, N. Y.; Midvale Steel & Ordnance Company, Coatesville and Johnstown, Pa.; and the Cambria Steel Company, Johnstown. The work will include improvements and enlargements in blast furnaces and mills, and the installation of additional equipment, carrying out an improvement program inaugurated a number of months ago. In order to provide funds for the expansion, the company has disposed of a bond issue of \$30,000,000, of which a substantial portion will be used for this purpose.

The Ford Motor Company, Highland Park, Detroit, Mich., is arranging for the equipment installation for its proposed steel mills at the River Rouge works, to consist of an 18-inch sheet bar mill, 18-inch billet mill, 32-inch billet mill, 42-inch continuous booming mill, 14-inch merchant bar mill, and miscellaneous structures. The plant is expected to develop a capacity of close to 100,000 tons of ingots and billets per month, while present plans call for extensions in the initial blooming mill at a later date. Three electric furnaces of Greaves-Etchells type will be installed, the largest with a capacity of 50 tons, and the two others each 10 tons. It is expected to have the mills ready for service towards the latter part of 1925.

The Pacific Sheet Steel Corporation, South San Francisco, Cal., has commenced operations at its new local sheet mills and plans to develop the plant to maximum capacity at an early date. It consists of six main structures, adjoining the works of the Pacific Coast Steel Company, which will furnish sheet bars for the mills, and is equipped for the production of black, galvanized and blue annealed sheets. The plant represents an investment of close to \$1,500,000, and will give employment to about 200 operatives. The Pacific Sheet Steel Corporation is operated by the Metal & Thermit Corporation, New York.

The West Coast Steel Company, Tacoma, Wash., is said to be perfecting plans for the rebuilding of the portion of its local mills, recently destroyed by fire with loss estimated at close to \$250,000, including buildings and equipment. The reconstruction at the same location, Pacific Avenue and Twenty-second Street, is estimated to cost approximately a like amount.

The Minnesota Steel Company, Duluth, Minn., has work in progress on improvements in its No. 1 blast furnace, including stack enlargement, relining and other betterment to completely modernize the unit. It is expected to have the furnace ready to blow in at an early date. The No. 2 furnace at the plant will be remodeled similarly at an early date,

with like increase in capacity and new shell. The company has work under way, also, on an addition to its merchant mill, to be equipped primarily for the manufacture of steel posts. Considerable machinery will be installed during the next month, and the extension placed in service shortly thereafter.

The Mystic Iron Works, Everett, Mass., a subsidiary of the Massachusetts Gas Company, Boston, has commenced preliminary work for its proposed local blast furnace, ore dock and auxiliary structures. The stack will be of 400 tons capacity, provided with four hot blast stoves, with electric power station and other accessory departments. A large battery of watertube boilers will be installed for steam service at the plant as well as to handle a by-products coke oven plant to be constructed on adjoining site. The furnace will be used for the production of pig iron from domestic and imported ores, and is expected to develop an output of about 150,000 tons per annum. This is to be the first of four such furnaces, it is stated, in this same district along the Mystic River. An extensive ore docks will be constructed for the unloading of ore and other materials direct from the vessels. To provide for the project, the parent company has disposed of a note issue of \$5,000,000. Freyn, Brassert & Company, Chicago, Ill., are consulting engineers.

The Penn-Seaboard Steel Corporation, Franklin Bank Bldg., Philadelphia, Pa., has approved an increase in its capital stock from 1,000,000 to 1,500,000 shares, a portion of the proceeds to be used for extensions and improvements at its plant, as well as for additions to working capital to provide for necessary expansion.

The Lockhart Iron & Steel Company, Connellsville, Pa., is said to have plans under way for the rebuilding of its local Sligo mill, destroyed by fire a number of weeks ago with loss estimated at \$300,000, including equipment. It is expected to invest close to a similar amount in the reconstruction.

The Troy Coke & Iron Company, Inc., Troy, N. Y., recently formed by officials of the Burden Iron Company, with local plant, has plans under way for the erection of a new steel mill on site selected, and expects to break ground at an early date. It will consist of a number of units with power plant, as well as foundry for steel casting service, and is estimated to cost in excess of \$1,200,000, including equipment, of which a list will soon be arranged. It is understood that the building construction will be handled by the Foundation Company, 120 Liberty Street, New York. The Burden company has filed notice of increase in capital from \$2,000,000 to \$3,500,000, a portion of the proceeds to be used for general expansion at the local mills.

The Youngstown Sheet & Tube Company, Youngstown, Ohio, has completed foundations and has superstructure work in progress for its proposed new sheet mill at the Brier Hill works. The structure will be of eight-mill type and is expected to be ready for initial service in the fall. It is expected to cost in excess of \$700,000.

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The Blast Furnace *and* Steel Plant

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PITTSBURGH, PA., JUNE, 1924

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